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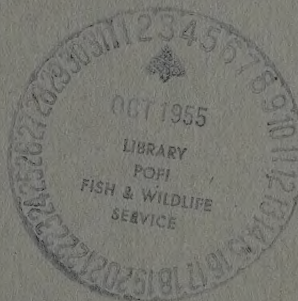
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ANTARCTIC PYRENOCARP LICHENS

by

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I. MACKENZIE LAMB, D.Sc.

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ANTARCTIC PYRENOCARP LICHENS

By I. Mackenzie Lamb, D.Sc.

(Plates I-IV; Text-figs. 1-4)

INTRODUCTION

THE number of species of Pyrenocarp lichens at present known to occur in the Antarctic is twenty, the genera represented being *Verrucaria*, *Thelidium*, *Staurothele*, *Microglaena*, *Dermatocarpon* and *Mastodia*. The genus *Endocarpon* has also been recorded (see p. 26), but its occurrence is doubtful and cannot at present be verified. Of these genera, *Microglaena*, *Dermatocarpon* and (technically) *Staurothele*¹ had not been previously recorded from this region. The material upon which the present study is based is mainly that collected by: (a) the Discovery Expeditions of 1931-3, 1933-5, and 1935-7; (b) the British Graham Land Expedition of 1934-7; and (c) the Falkland Islands Dependencies Survey (during the period 1944-6), with which I served in the capacity of Botanist. In addition, the material collected by the following earlier expeditions has been revised and included in this paper: (a) James Clark Ross's 'Erebus and Terror' Expedition of 1839-43; (b) the Belgian Expedition of 1897-9; and (c) the Swedish Expedition of 1901-3.

In connexion with these studies, I should like to express my thanks to the authorities of the following institutions: (a) the British Museum (Natural History), London, for a grant of money and special leave whereby I was enabled to study the material in the Vainio collection at Turku, Finland; (b) Turun Yliopiston Kasvitieteellinen Laitos, Turku, for all facilities placed at my disposal during my study of the material of the Belgian Expedition there in 1937; and (c) the Naturhistoriska Riksmuseet, Stockholm, for the loan of some of the specimens collected by the Swedish Expedition. I am also grateful to my colleagues of the Falkland Islands Dependencies Survey, Major Andrew Taylor, Lieut. E. H. Back, Lieut. D. James, and Capt. V. Russell, for assistance in the collection and observation of lichen specimens during the sledging trips, and to my friend Dr Rolf Santesson of Uppsala for the benefit of his help and advice on the ecological terminology of the marine species.

HISTORICAL SURVEY OF LICHENOLOGICAL WORK IN THE ANTARCTIC

A good general account of botanical exploration in the antarctic regions has been published by Skottsberg (1940). A brief survey of the lichenological field work done by the various expeditions is appended here, and the map on p. 4 shows the localities in the Graham Land sector where lichen collections have been made.

The first recorded collection of lichens from south of 60° lat. is that of James Eights, who visited the South Shetlands in 1830. His scientific work there has been reviewed by Calman (1937).

The 'Erebus and Terror' Expedition of James Clark Ross, which visited the Antarctic in the years 1839-43, was accompanied by the famous botanist J. D. Hooker. His antarctic collections were made on Cockburn Island, a small island of basalt and agglomerate lying in the Erebus and Terror Gulf on the east side of the Graham Land peninsula. A preliminary list of these lichens was published by Hooker and Taylor (1844), and a more comprehensive enumeration of nine species, in Hooker's *Flora Antarctica* (1845-7).

¹ Already recorded under the old comprehensive generic name *Verrucaria* by Hooker (1845-7).

Dumont d'Urville visited Adélie Land in 1840, and landed on a rocky islet off the coast in the neighbourhood of 'Pointe Géologie'; he collected rock specimens, but 'of vegetation nothing was seen' (according to Fricker, 1900).



Fig. 1. The Graham Land peninsula and adjacent islands, showing localities where collections of lichens have been made.

A lapse of over 50 years now intervened until in 1895 Borchgrevink landed from the steam whaler 'Antarctic' on Possession Island and Cape Adare, in South Victoria Land, and collected one species of lichen (see Fricker (1900), where further references are given).

The first comprehensive lichen collections were made by the Belgian Antarctic Expedition of 1897-9. Fifty-five species of lichen were collected on the west coast of the Graham Land peninsula, and sub-

sequently classified by Vainio (1903). Twenty-eight of these species and one lichen parasite proved to be new to science, together with several varieties and forms.

The 'Southern Cross' Expedition of 1898-1900, led by Borchgrevink, carried out scientific work in South Victoria Land, and a few lichens were collected in what was then known as Geikie Land, not far from Cape Adare. The official scientific report of this expedition was published by the British Museum, and in it four species of lichen, all previously known, were recorded by Blackman (1902). This material is preserved in the British Museum herbarium. Other lichen material collected by the same expedition was submitted to Prof. Th. M. Fries, who also enumerated four species (1902), with one new form of *Lecanora chrysoleuca*. This material is presumably in Th. Fries's herbarium at Uppsala.

In the year 1901 three independent expeditions left for the Antarctic: (a) the British National Antarctic Expedition; (b) the Swedish South Polar Expedition; and (c) the German South Polar Expedition.

The British National Antarctic Expedition of 1901-4 brought back a collection of lichens from the region around the McMurdo Sound in South Victoria Land, partly from near the winter station of the 'Discovery' and partly from altitudes of 500-1600 m. on Mt Terror and in the West Mountains at the head of the Ferrar Glacier. In this collection Darbishire (1910) identified twenty-four species of which five were new to science. The material is preserved in the box collection of the British Museum.

The Swedish South Polar Expedition of 1901-3 reached the South Shetlands in 1902, and lichens were collected by the eminent botanist and phytogeographer Carl Skottsberg both there and along the Gerlache Strait and the eastern side of the Trinity Peninsula. Unfortunately, much of the scientific material was lost when the 'Antarctic' was crushed in the ice in 1903, but a number of specimens, including lichens, were preserved, in conditions of great hardship and difficulty, throughout the enforced sojourn of the party on Paulet Island until they were relieved the following season. The lichens were dealt with by Darbishire (1912). Species from south of 60° lat. numbered forty-six (plus one lichen-parasite), of which nine were new to science. This collection, apart from a few duplicate specimens in the Kew Herbarium, is at the Naturhistoriska Riksmuseet in Stockholm. Some of Darbishire's new species have been redescribed by Zahlbruckner (1917) and Magnusson (1929).

The German South Polar Expedition of 1901-3 visited Kaiser Wilhelm II Land in what is now the Australian Antarctic Territory. Three lichens were taken from the Gaussberg, and were subsequently identified by Zahlbruckner (1906), who found one of them to be the type of a new variety. They were preserved at Berlin-Dahlem.

Simultaneously with the Swedish and German Expeditions, the Scottish National Antarctic Expedition of 1902-4 was working at the South Orkneys, and several lichens were brought back from there to be named by Darbishire, who recorded eleven species, one of which, a fruticulose *Placodium*, was considered to be new at the time (Darbishire, 1905), but subsequently found to be identical with Vainio's *P. regale* (Darbishire, 1912a). I have not succeeded in discovering the whereabouts of this collection, but Prof. R. N. Rudmose Brown kindly sent to the British Museum a few previously overlooked unnamed specimens gathered by this expedition, of which he was a member.

In 1903 Dr Charcot took the field with the first French Antarctic Expedition. This returned in 1905, after wintering at Booth (Wandel) Island in the Kaiser Wilhelm II Archipelago. A small collection of lichens was made and submitted to the Abbé Hue for identification. Of the sixteen species present four (and a lichen-parasite) were considered to be new (Hue, 1908). I saw some of the type material at the Muséum d'Histoire Naturelle, Paris, in 1936.

At least one lichen was collected in the South Orkneys by a visitor named Edgar Szumla in 1904. This information is derived from the recent publication by Frey (1936) of a new variety of *Umbilicaria Dillenii* based on this collector's material from there, and present in the Berlin Museum.

The next expedition to visit the Antarctic was Shackleton's first British Antarctic Expedition of 1907-9. A base was established at Cape Royds in McMurdo Sound, South Victoria Land. Mt Erebus (about 4250 m.) was ascended, and both geological and botanical collections were made. These included thirteen lichens, of which a list, including one new species, was published by Darbishire (1923). I have not been able to trace this interesting collection.

Charcot's second French Antarctic Expedition of 1908-10 was organized with very complete provision for scientific research. Numerous landings were made along the western coast of the Graham Land peninsula, and rich biological collections brought in. The lichens were subsequently examined by Hue, whose report on them (1915) enumerates 112 species, of which no less than ninety were supposedly new to science. This apparent preponderance of endemic species has since been found to be to a large extent illusory, being due to Hue's inelastic conception of the species concept and his failure to allow for ecologically conditioned variation. The material, for the most part brought back *in situ* on large blocks, unfortunately appears to have been lost; a search for them at the Muséum d'Histoire Naturelle, Paris, in 1936 brought to light only a few of the smaller specimens which had been incorporated in the general lichen herbarium.

It is known that botanical specimens were collected in King Edward VII Land by Lieut. Prestrud of the Norwegian Antarctic Expedition of 1910-12, but apparently no account of the lichens has ever been published.

Scott's last British Antarctic Expedition of 1910-13 brought back seventeen species of lichen from Cape Adare and Evans Coves in South Victoria Land. They were treated by Darbishire (1923*a*) who found eight of them to be new to science. They are preserved at the British Museum, partly in the herbarium and partly in the box collection.

Mawson's Australasian Antarctic Expedition of 1911-14 carried out biological investigations in Adélie Land and Queen Mary Land. According to Dodge and Baker (1938), the report on the lichens still awaits publication.

In the years 1914-17 Shackleton undertook his second, or Transantarctic Expedition. The party was marooned on Elephant Island in the South Shetlands, and two lichens collected from there were named by Darbishire (1923).

The Shackleton-Rowett Expedition of 1920-2 again visited Elephant Island, and a lichen was noted on some of the rocks (Wild, 1923, p. 335). The specimen, now in the British Museum, is a *Neuropogon*.

Mention should be made here of several small collections of lichens made in the South Orkneys and Shetlands by A. G. Bennett on various occasions between 1913 and 1925, and presented by him to the British Museum.

A series of Norwegian expeditions were made in the years 1926-37 under the direction of Consul Lars Christensen, and the Antarctic coast was visited in various sectors. The scientific material collected will, it is understood, be published by the Norwegian Academy of Science.

Adm. Byrd's first American Expedition of 1928-30 visited King Edward VII Land and South Victoria Land. According to Dodge and Baker (1938), no report on the lichens has yet been published.

The British Australian and New Zealand Antarctic Research Expedition of 1929-31 worked mainly on the subantarctic islands of the Southern Ocean, but landings were also made on the Antarctic continent in Adélie Land and MacRobertson Land and some lichens collected there. The material is being identified by Prof. Carroll W. Dodge.

Rich collections of lichens from the South Orkneys and Shetlands were made during three of the expeditions of the R.R.S. 'Discovery II' in the years 1931-3, 1933-5, and 1935-7, and were presented to the British Museum. Some of them are dealt with in the present paper.

The second American Antarctic Expedition of 1933-5 visited Marie Byrd Land, King Edward VII

Land, and South Victoria Land. An unusually large collection of cryptogams was made by trained biologists. The lichens were subsequently studied by Dodge and Baker, who (1938) identified eighty-nine species, of which no less than eighty-four were new to science. This remarkable degree of endemism (even allowing for reduced forms which may eventually prove to belong to already known species) may seem surprising, but it must be remembered that most of the collections were made in hitherto unvisited regions. The types are preserved at the Missouri Botanical Garden, St Louis, U.S.A.

The British Graham Land Expedition of 1934-7 worked along the western coast of Graham Land south to Alexander Land, which was found to be much more extensive than was previously supposed. Large and fine collections of lichens were made, and particular attention was paid to their ecological relationships. The material has been presented to the British Museum, and has been used in the compilation of the present paper.

In 1938 a German Antarctic Expedition, under the command of Capt. Ritscher, left Germany for the Antarctic on the 'Schwabenland'. A staff of scientists was carried, and biological collections were made on the Antarctic continent around the zero meridian, i.e. in the Queen Maud Land sector. The expedition returned to Germany in April 1939. A preliminary account of the scientific results was published in 1939 in the *Annalen der Hydrographie und maritimen Meteorologie* (according to the *Polar Record*, IV, no. 31, 1946).

The third American Antarctic Expedition under Adm. Byrd spent the years 1939-41 in the exploration of the regions between Marie Byrd Land and Alexander Land. Two bases were established, a western near Little America in the Bay of Whales, and an eastern on Stonington Island in Marguerite Bay, west Graham Land. Several sledging parties traversed the Graham Land peninsula; one of them followed the east coast of the peninsula southwards to lat. $70^{\circ} 51'$. Another party reached the Eternity Range, discovered by Lincoln Ellsworth. King George VI Sound was found to separate Alexander I Land completely from the mainland. Botanical collections were made from both the western and the eastern bases. Much of the material collected at the eastern base, however, had to be abandoned owing to the emergency evacuation of the personnel by air, but a representative selection of botanical specimens was taken. Lichens were also collected in the Melchior Islands in Dallmann Bay. The material is being studied by Prof. Carroll W. Dodge.

Finally, the Falklands Islands Dependencies Survey,¹ sponsored by the British Colonial Office, established three bases in the Graham Land Sector in 1944-5: (a) at Deception Island, South Shetlands; (b) at Port Lockroy, Wiencke Island (in the Palmer Archipelago); and (c) at Hope Bay on the Trinity Peninsula, a locality already visited in 1902 by the Swedish Expedition. Intensive collecting and ecological work was done around the bases, and in 1945 two sledge journeys were made from the Hope Bay base down the east coast of the peninsula to extend the survey of the Swedish Expedition. Numerous botanical collections were made during these journeys, in many cases from islands and headlands discovered for the first time, and as yet unnamed. For this reason I will refer to these botanical localities provisionally by station numbers, indicated on the accompanying map, and listed as follows:

- St. 24. Headland in approx. lat. $63^{\circ} 33'$, long. $57^{\circ} 22'$.
- St. 25. Headland in approx. lat. $63^{\circ} 38'$, long. $57^{\circ} 34'$.
- St. 26. Headland in approx. lat. $63^{\circ} 40'$, long. $57^{\circ} 48'$.
- St. 27. Island in lat. $63^{\circ} 37'$, long. $57^{\circ} 19'$.
- St. 28. Island in lat. $63^{\circ} 40'$, long. $57^{\circ} 28'$.
- St. 29. Island in lat. $63^{\circ} 40'$, long. $57^{\circ} 35'$.
- St. 30. Island in lat. $63^{\circ} 40'$, long. $57^{\circ} 40'$.
- St. 31. Islet in approx. lat. $63^{\circ} 43'$, long. $57^{\circ} 37'$.

¹ Until the end of 1945 the Survey was known as 'Operation Tabarin'.



Fig. 2. The east coast of the Trinity Peninsula, Graham Land, showing positions of the collecting stations. (Based on the survey made by Major Andrew Taylor, R.C.E., assisted by Capt. Victor Russell, R.E., in 1945.)

- St. 33. Island in lat. $63^{\circ} 45'$, long. $58^{\circ} 10'$.
- St. 34. Headland in approx. lat. $63^{\circ} 49'$, long. $58^{\circ} 20'$.
- St. 38. Islet in approx. lat. $63^{\circ} 58'$, long. $58^{\circ} 36'$.
- St. 46. Islet in approx. lat. $63^{\circ} 59'$, long. $57^{\circ} 23'$.
- St. 48. Projecting headland on south side of Vega Island.
- St. 51. Site of camp on shore of James Ross Island in Sidney Herbert Sound.
- St. 52. Valley on coast of James Ross Island in Sidney Herbert Sound.
- St. 62. A concealed fresh-water lake on the west side of James Ross Island.
- St. 66. Headland on James Ross Island, west side, in Röhss Bay.
- St. 73. Headland (perhaps formerly islet) adjoining the Naze, north coast of James Ross Island.
- St. 75. Locality on James Ross Island on the west side of the bay forming the southern extension of Sidney Herbert Sound.
- St. 77. Headland in approx. lat. $63^{\circ} 38'$, long. $57^{\circ} 08'$.

GEOGRAPHICAL DISTRIBUTION

It has long been known that the antarctic flora includes a considerable bipolar element, consisting of species which occur also in the Arctic (with or without outlying occurrences at high altitudes in the temperate northern hemisphere). The phenomenon has been fully treated in a recent paper by Du Rietz (1940). Whether these species have originated in the Arctic and spread across the equator to the Antarctic, or vice versa, is a matter for surmise. Du Rietz (1929) is of the opinion that the area of greatest specific differentiation of a genus is most likely to be that in which it originated. If this is so, then certain predominantly antarctic and subantarctic bipolar lichen genera, such as *Sphaerophorus*, *Placopsis* and *Neuropogon*, must be of southern origin. In the Antarctic, the bipolar element is much more strongly represented in the Graham Land region than in the Ross Sea sector, the only other area of which the lichen flora is sufficiently well known to permit of any comparison. This may be due to one or both of two factors: (a) the lesser distance separating the Graham Land sector from the adjacent land masses; and (b) the existence of a more continuous montane pathway of migration, along the Cordilleran chain and the Rockies, than is available in the eastern hemisphere. There is actual evidence of Cordilleran migration in the case of *Neuropogon sulphureus* (Lamb, 1939). Among the antarctic Pyrenocarp lichens, the delimitation of the term 'bipolar' presents some difficulties. At one end of the scale there is *Mastodia tessellata*, very strictly bipolar in its distribution (subantarctic and antarctic southern hemisphere, arctic eastern Siberia). *Dermatocarpon intestiniforme* is a good representative of those bipolar species which also possess an outlying alpine areal in the temperate northern hemisphere. Of the marine species, *Verrucaria ceuthocarpa* can be regarded as bipolar, although it penetrates into temperate Europe and North America; with the other species, *V. maura*, *V. microspora* and *V. mucosa*, the extension into the temperate zone is so marked that the term 'bipolar' becomes hardly applicable.

Species apparently endemic to the Graham Land peninsula and adjacent islands are *V. cylindrophora*, *V. dispartita*, *V. elaeoplaca*, *V. famelica*, *V. psychrophila*, *V. Racovitzae*, *V. serpuloides* and *Microglæna antarctica*. The only Pyrenocarp lichens known to date from the Ross Sea area¹ are *Thelidium inaequale* and *Th. parvum*, both endemic to that region.

¹ Apart from the doubtful record of the genus *Endocarpon* by Darbishire (1910).

Verrucaria tessellatula is a subantarctic-bicentric, or perhaps circumpolar, species with an extension into the antarctic in the Graham Land sector. *Staurothele gelida* is also subantarctic-antarctic in its distribution, but apparently confined to the South American sector.

Consideration of these endemic antarctic and subantarctic species raises the question of vicarious representation, which has been touched upon by Degelius in his studies of the relationships between the lichen floras of Europe and North America (1940). He finds that in addition to vicarious species which simply replace each other in the two areas under consideration, there is a second type, for which he proposes the term 'subvicarious species', in which nearly related species almost, but not entirely, replace each other in their distribution. It is interesting to find the same phenomenon among the lichens of the northern and southern hemispheres. One of the best examples of such a subvicarious pair is furnished by the two species of *Neuropogon*, *N. sulphureus* and *N. antarcticus* (Lamb, 1939). The former is the only representative of the genus in the Arctic; the latter, very closely allied morphologically, largely takes its place in both the Falklands sector and the Ross Sea area, but *N. sulphureus* is also present, notably on the eastern side of the Graham Land peninsula. Instances of bipolar vicarious and subvicarious species among the Pyrenocarp lichens can be tabulated as follows:

Northern hemisphere	Southern hemisphere
Vicarious species	Vicarious species
<i>Verrucaria striatula</i> subsp. <i>borealis</i> Santesson (1939)	<i>Verrucaria striatula</i> subsp. <i>australis</i> Santesson (1939)
<i>Verrucaria cataleptoides</i> Nyl.	<i>Verrucaria Racovitzae</i> Vain.
<i>Staurothele clopima</i> (Wbg.) Th. Fr.	<i>Staurothele gelida</i> (Hook. and Tayl.) M. Lamb
Subvicarious species	Subvicarious species
<i>Verrucaria microspora</i> Nyl.	<i>Verrucaria dispartita</i> Vain. + <i>V. microspora</i> Nyl.
<i>Verrucaria ceuthocarpa</i> Wbg.	<i>Verrucaria tessellatula</i> Nyl. + <i>V. ceuthocarpa</i> Wbg.

Finally, one of the species, *Dermatocarpon lachneum*, appears to belong to the group to which the name 'cosmopolitan' or 'ubiquistic' is applied.

ECOLOGY

In respect of habitat ecology, one group of Pyrenocarp lichens (comprising chiefly *Verrucaria* and *Arthopyrenia*) is peculiar in being amphibious in the littoral zone (Santesson, 1939). Some of these, like *Verrucaria mucosa*, are plants of the upper hydrohaline, intermittently submerged by the tide; others, of which *V. maura* is a good example, are more or less restricted to the lower hygrohaline or spray zone, above the high tide level. *V. mucosa* has hitherto been regarded as one of the most marine lichens, but in this respect it is now found to be surpassed by *V. serpuloides* (p. 20), a new species of entirely marine habitat, never or only accidentally exposed to the air.

On land also many Pyrenocarp lichens are characteristic of wet situations (fresh-water species). Such are also found in the Antarctic, but there, on account of the peculiar climatic conditions, may be actually in contact with liquid water for only a short period in every season (especially *V. elaeoplaca*, p. 15). Some of the antarctic species of this hydrophyte group are also markedly nitrophilous, absorbing ammoniacal decomposition products in solution from the snowmelt water with which they are periodically inundated.

What is known of the habitat ecology of the various antarctic Pyrenocarp lichens is summarized in the following table:

I. Terrestrial species:

- (a) Non-hydrophilous species: *Verrucaria famelica* (nitrophilous),¹ *Thelidium inaequale*,² *Th. parvum*,² *Microglæna antarctica* (nitrophilous), *Dermatocarpon lachneum*, *Mastodia tessellata* (nitrophilous).
 (b) Hydrophilous species:
 i. Nitrophilous species. *Verrucaria elaeoplaca*, *V. Racovitzae*, *V. cylindrophora*.
 ii. Non-nitrophilous species. *Staurothele gelida*, *Dermatocarpon intestiniforme*.

II. Marine species:

- (a) Species of the lower Hygrohaline (salt-spray zone). *Verrucaria ceuthocarpa*, *V. dispartita*, *V. maura*, *V. tessellata*.
 (b) Species of the upper Hydrohaline (intertidal zone): *Verrucaria microspora*, *V. mucosa*, *V. psychrophila*.
 (c) Species of the middle Hydrohaline (below the lowest ebb tide level): *Verrucaria serpuloides*.

SYSTEMATIC ACCOUNT

Order PYRENOCARPEÆ

Family VERRUCARIACEÆ

Genus *Verrucaria* Wiggers, 1780³

Key to the species of Graham Land and adjacent islands

1 a. Excipulum entirely dark brown in section.

2 a. Thallus blackish, thin, filmy, not rimose; continuous or in scattered patches.

3 a. Spores cylindric *V. cylindrophora*

3 b. Spores ellipsoid.

4 a. Perithecia (and usually thallus) minutely scabrid under $\times 10$ lens *V. dispartita*

4 b. Perithecia and thallus smooth, shining *V. microspora* f. *frisiaca*

2 b. Thallus rimose or areolate.

5 a. Thallus black or brown-blackish, finely cracked-areolate; excipulum about 200μ diam. *V. maura*

5 b. Thallus glaucous-olivaceous or buff coloured, rimose or reticulate-rimose; excipulum about 450μ diam. *V. Racovitzae*

1 b. Excipulum colourless in section.

6 a. Thallus continuous, smooth, effuse or in scattered patches or sometimes almost evanescent, not rimose.

7 a. Perithecia not or hardly prominent above surface of thallus *V. mucosa*

7 b. Perithecia prominent.

8 a. Perithecia hemispherical to subglobose, 0.15-0.25 mm. diam.

9 a. Spores $18-20 \times 7.5-8.0\mu$ *V. famelica*

9 b. Spores $7-12 \times 4-5\mu$ *V. microspora*

8 b. Perithecia truncate-subconical, 0.30-0.45 mm. diam. *V. serpuloides*

¹ As far as one can judge from the remarks of Skottsberg (1912, p. 6).

² As far as can be ascertained from the published observations of Siple (1938).

³ In the list of species attributed by him to this genus Wiggers does not include any belonging to *Verrucaria* in the modern delimitation.

6b. *Thallus rimose.*

10a. Cracks black.

11a. Thallus uniformly tessellate-areolate with areolae 0.5–1.0 mm. diam. *V. tessulatula*11b. Thallus not areolate, but with gaping cracks often reticulating to delimit irregular areas of variable size (1–10 mm.) ... *V. tessulatula* f. *dermoplaca*
[Thallus composed of confluent microthalli separated by blackish lines and
simulating large flat areolae ... *V. elaeoplaca* f. *glaucoplaca*]10b. Cracks between areolae $\pm$ concolorous with rest of thallus.11a. Areolae up to 1 mm. diam. ... *V. ceuthocarpa*

11b. Areolae larger.

12a. Thallus buff-brown or olivaceous-glaucous; spores usually $14-18 \times 8-11 \mu$;
fresh-water species ... *V. elaeoplaca*12b. Thallus olive-blackish; spores $11-13(-15) \times 6-7 \mu$; marine species ... *V. psychrophila****Verrucaria ceuthocarpa* Wahlenberg (Fig. 3b).**

apud Acharius, 1803, suppl. p. 22; Vainio, 1909, p. 163, 1921, p. 72; Zschacke, 1934, p. 194.

WEST GRAHAM LAND. *Palmer Archipelago*: Port Lockroy, Goudier Islet; east and south-east sides of islet, on basalt dykes about 1 m. above high-water level, in the rough weather spray zone; F.I.D.S., 23. iv. 1944 (no. 1227); 28. xii. 1944 (no. 2119); on granodiorite face slightly above high-water level, in the spray zone; F.I.D.S., 23. iv. 1944 (no. 1222 *pr. p.*).

Forming effuse, indeterminate, discontinuous patches. Thallus thin, olivaceous-blackish, entirely rimose-areolate, with areolae 0.3–0.7 mm. diam. The specimens more or less correspond to the typical form of the species (var. *areolatodiffracta* Vainio, 1909). Perithecia minute, not over 0.2 mm. diam., with prominent, almost hemispherical, black apex. Excipulum colourless below and at sides. Spores $9-12 \times 6-7 \mu$.

GEOGRAPHICAL DISTRIBUTION. New to the Eu-antarctic zone; previously recorded from northern Europe, Spitsbergen, Bear Island, Novaya Zemlya, north-east Siberia, Bering Strait, Greenland, North America (Maine and Massachusetts), and in the southern hemisphere, Kerguelen (Müller Argoviensis, 1884, p. 139¹). According to Lynge (1937, p. 13), it is the commonest marine *Verrucaria* in the Arctic.

Var. *deformata* Vainio

1909, p. 164.

WEST GRAHAM LAND. *Palmer Archipelago*: Port Lockroy, Goudier Islet; south side of islet, 0.5–1.5 m. above high-water level, on granodiorite rock face in the rough weather spray zone; F.I.D.S., 23. iv. 1944 (no. 1222); 25. iv. 1944 (no. 1223); 7. i. 1945 (no. 2190).

'Thallus sat crassus, areolatus aut areolato-diffractus, areolis difformibus, majoribus vel minoribus, saepe leviter inaequalis et habitu quasi morbosus, olivaceo- aut pallide-olivaceo- et nigricanti-variegatus, opacus' (Vainio, loc. cit.). I have not seen an authentic specimen of this variety, but if I am correct in referring the present specimens to it, the 'morbous habitus' and pale olivaceous variegation mentioned by Vainio is due to numerous algal efflorescences on the thallus caused by proliferation of the thalline gonidia. These scattered, olivaceous-greenish, soredia-like, erumpent, mealy-granulose outgrowths are 0.15–0.30 mm. diam., and in sections through the thallus are seen to be masses of gonidial algae in a state of rapid multiplication, forming pairs, tetrads, and octants, and rupturing the thalline cortex in emerging. They are not accompanied by hyphal filaments, and hence cannot be classed as soredia.

¹ Müller, loc. cit., quotes the Kerguelen locality as being 2000 feet above sea level, which makes the record seem improbable.

Var. submembranacea M. Lamb, n.var.

WEST GRAHAM LAND. *Palmer Archipelago*: Port Lockroy, Goudier Islet; south side of islet, about 1 m. above average sea-level, in the spray zone, on an almost vertical granodiorite face; F.I.D.S., 16. xii. 1944 (no. 1994).

DESCRIPTION. *A forma typica differt thallo tenui (ad 0.13 mm. crasso), submembranaceo, fere continuo (rimis paucis angustissimis vel pr. maj. parte tantum lineolis nigricantibus parum conspicuis indicatis). Thallus plagulas irregulares, ambitu saepe obsolete pallido-zonatas, demum sat late confluentes format; passim sat crebre glomerulis sordide olivaceis (e efflorescentia gonidiorum ortis) ad 0.3 mm. latis obsitus.*

Thallus olivaceous-blackish in the living state, smooth, matt, with very few open cracks; most of the cracks appear to have closed up and are indicated only here and there by very fine dark lines. The relationship to the typical form and the var. *deformata*, both of which occur close by, is unmistakable. Perithecia scarce, up to 0.17 mm. diam., typical; spores $10-12 \times 6.0-7.5 \mu$.

I was unable to detect any zonal differences between these two varieties and the typical form. They occur together with *Caloplaca cirrochrooides* (Vain.) Zahlbr. and another halophile *Caloplaca* not yet determined. All of them become crusted over with salt-water ice to a thickness of 5 cm. in late May, and remain thus encased throughout the winter.

Verrucaria ceuthocarpa is closely allied to *V. tesselatula* Nyl. (p. 21); the latter differs in the paler thallus with somewhat larger areolae separated by conspicuous black cracks.

Verrucaria cylindrophora Vainio (Pl. IV, fig. 4)

1903, p. 38.

Not found in the present collections, and known only from the type locality (west Graham Land: Palmer Archipelago, Moreno Island). My reinvestigation of the holotype in herb. Vainio (Exped. Antarct. Belge, no. 196 *pr. p.*) gave the following information:

On non-calcareous fine-grained rock. Thallus extremely thin, a mere film, continuous, black, slightly shining. No visible hypothallus. Perithecia very numerous, evenly scattered, minute, up to 0.15 mm. diam., black, $\times$ hemispherical, matt or slightly shining, not impressed or papillate at apex; ostiole invisible. Paraphyses diffused, indicated by faint striae in the mucilage. Asci clavate, $20-27 \times 8-10 \mu$, thin-walled. Spores 6-7 (-8?) in ascus, in vertical polyseriate arrangement, cylindrical, straight, rounded at ends, thin-walled, $10.5-12.0 \times 2.5-3.0 \mu$. Hymenial gelatine faintly pink with iodine.

The holotype occurred together with *V. elaeoplaca*, which indicates a habitat on fresh-water inundation surfaces.

Verrucaria dispartita Vainio (Fig. 31; Pl. IV, fig. 6)

1903, p. 38.

WEST GRAHAM LAND. *Palmer Archipelago*: Port Lockroy, Goudier Islet; south side of islet, on vertical rock face just above high-water level, constantly drenched with spray in rough weather; F.I.D.S., 23. iv. 1944 (no. 1222 *pr. p.*).

EAST GRAHAM LAND. *Trinity Peninsula, south coast*: Hope Bay; small islet in the bay, on steep rock face in the spray zone about 0.5 m. above high-tide level; F.I.D.S., 20. xii. 1945 (no. 2564 *pr. p.*).

The specimens agree well with the holotype specimen in herb. Vainio (Exped. Antarct. Belge, no. 199), upon which the following description is based.

On fine-grained non-calcareous rock. Thallus represented by very scattered minute sooty patches and spots 0.3-0.8 mm. diam., hardly 0.1 mm. thick. Surface of thallus matt, seen to be very minutely roughened (but not punctate) under $\times 12$ lens. No hypothallus. Perithecia numerous on thalline

patches, 0.2–0.3 mm. diam., $\pm$ hemispherical, black, matt (shining only where rubbed), with minutely scabrid surface like the thallus; solitary or two to three crowded together and then often conrescent. Ostiole indistinct, not papillate or impressed. Excipulum brown to dark brown in section, entire. Paraphyses dissolved, indicated by faint striae in the mucilage. Asci cylindric-clavate, $30\text{--}40 \times 8\text{--}12 \mu$, thin-walled. Spores ellipsoid, 8 in ascus, $8\text{--}11 \times 4.5\text{--}5.5 \mu$. With iodine, hymenial mucilage rose-pink, asci and spores yellowed.

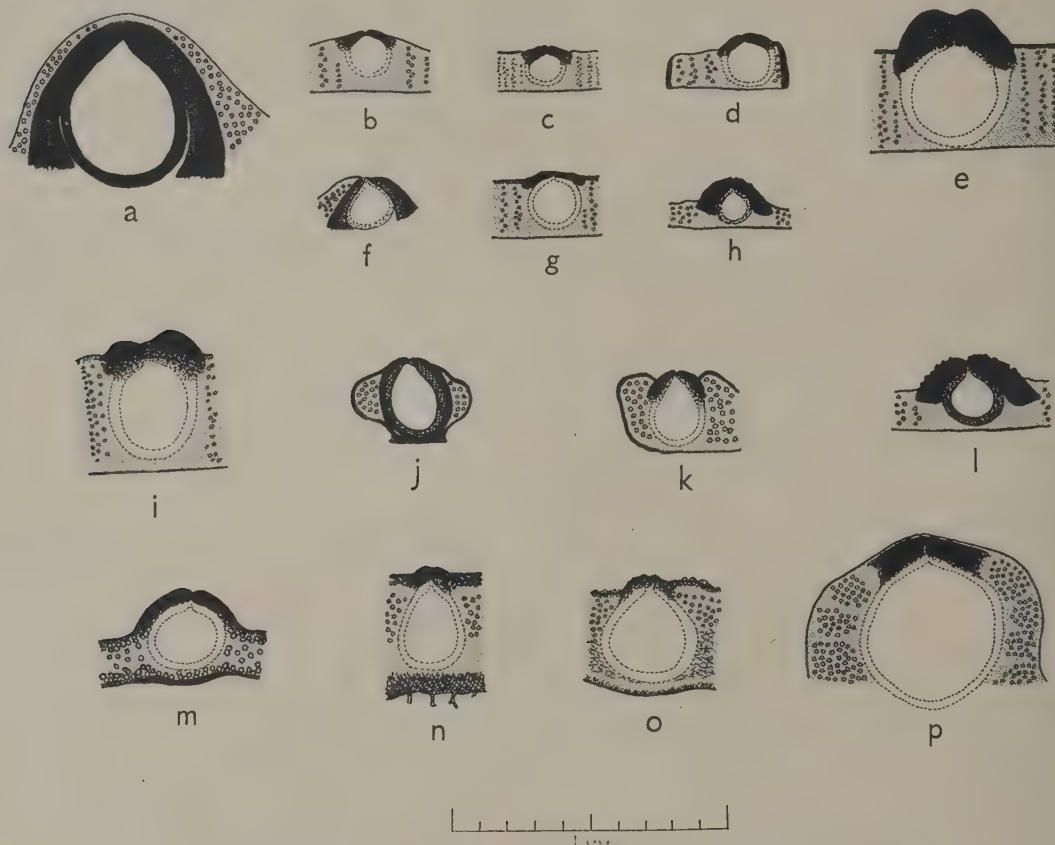


Fig. 3. Perithecial structure in Antarctic Pyrenocarp lichens. (Somewhat diagrammatic.)

a, *Verrucaria Racovitzae*.
b, *Verrucaria ceuthocarpa*.
c, *Verrucaria mucosa*.
d, *Verrucaria tessellatula*.
e, *Verrucaria serpuloides*.
f, *Verrucaria famelica*.

g, *Verrucaria psychrophila*.
h, *Verrucaria microspora* (f. *frisiaca*).
i, *Verrucaria elaeoplaca*.
j, *Staurothele gelida* (with poorly developed thallus).

k, *Staurothele gelida* (with well developed thallus).
l, *Verrucaria dispartita*.
m, *Mastodia tessellata*.
n, *Dermatocarpon lachneum*.
o, *Dermatocarpon intestiniforme*.
p, *Microglaena antarctica*.

This species comes very near *V. microspora* (f. *frisiaca*), differing only in the minutely scabrid, often somewhat cracked thallus, usually slightly roughened perithecia and the somewhat darker excipular wall. Its habitat ecology, however, is different, its occurrence being in the spray zone and not in the intertidal belt, as is the case with *V. microspora*. No. 2564 pr. p. was associated with *Caloplaca cirrochroides* (Vain.) Zahlbr., in the upper part of the spray zone. In our specimens the thallus forms scattered spots or effuse, $\pm$ continuous patches of small extent, it is sooty or olivaceous-blackish, about 0.1 mm. thick, continuous or with small sporadic disconnected cracks or (in no. 2564 pr. p., which grew

in a drier position) with fine reticulately anastomosing cracks in the thicker parts of the thallus around the perithecia. Gonidial algae bright green, $6-8\ \mu$ diam. Excipulum spherical, (100-) $165-195\ \mu$ diam., with wall $18-21\ \mu$ thick; inner $9\ \mu$ dark brown, the outer part pale brown. Spores $9-12(-13) \times 4.5-6.0(-7)\ \mu$. The minute roughening of the thallus is very inconspicuous, not to be compared with the punctate or wrinkled scabrosity of some other marine species (*Verrucaria scotina*, etc.).

GEOGRAPHICAL DISTRIBUTION. Previously known only from the type locality (west Graham Land: Cape Anna, on the mainland coast between Cape Charles¹ and Cape Renard).

Verrucaria elaeoplaca Vainio (Fig. 3i; Pl. II, fig. 2; Pl. III, figs. 1, 2)

1903, p. 37, pl. i, fig. 6.

Verrucaria glaucoplaca Vainio, 1903, p. 37, pl. i, fig. 5; Hue, 1915, p. 182.

WEST GRAHAM LAND. *Palmer Archipelago*: Port Lockroy, Goudier Islet; near summit of islet, altit. about 7 m. on granodiorite rocks irrigated intermittently by snowmelt water; F.I.D.S., 29. ii. 1944 (no. 1151 *pr. p.*); 26. iii. 1944 (no. 1179); 7. v. 1944 (no. 1234); 26. xi. 1944 (no. 1801); 28. xi. 1944 (no. 1833 *pr. p.*). *Argentine and neighbouring Islands*: Berthelot Islands; on dioritic rocks; B.G.L.E., 18. iii. 1935 (nos. 1081-18, 1081-25, 1090, 1094-9, 1094-10, 1094-14, 1094-46, 1094-73, 1094-84, 1095-2).

EAST GRAHAM LAND. *Trinity Peninsula, south coast*: Hope Bay; near Boeckella Lake, altitude *c.* 60 m., on non-calcareous stones half submerged in a frozen shallow fresh-water pool; F.I.D.S., 15. iv. 1945 (no. 2363).

The commonest *Verrucaria* in the Graham Land sector of the Antarctic. It is a very distinct species, without obvious affinities.

The thallus covers large continuous areas, and is not effigurate at periphery, but often bounded by a very narrow whitish zone, inside which is a thin brown-blackish line. There is no dark hypothallus. Thallus (in the typical condition) verrucose-areolate, with $\pm$ tumid and convex, irregularly obtusely angulose areolae $1.2-2.0(-3.0)$ mm. diam., separated by deep, incised, pale-edged cracks about 0.15 mm. wide; thickness varies between 0.3 and 1.0 mm. (rarely up to 2.5 mm.). Surface matt, smooth, not pruinose, usually pale dull buff-brown (corresponding to pl. xlv, 17''', 19''' and 21''' *b* in Ridgway, 1912), in less exposed positions paler, grey-brown with a slight pinkish tinge (Ridgway, pl. xlv, 17''' *d*, 21''' *d*), or in very shady positions grey-greenish (Ridgway, pl. xlv, 21''' *b-d*). In certain places where the thallus is subject to heavy inundation with water strongly impregnated with nitrogenous matter, it takes on a red tinge (Ridgway, pl. xlv, 13''' *b*; exceptionally pl. xxxix, 9''' *a-b*), either entirely or in scattered spots and patches. In the normal brown state the thallus has a reddish brown cortex $9-15\ \mu$ deep, composed of iso-diametric, thin-walled cells $3-4\ \mu$ diam., in many places overlaid by a hyaline amorphous necrotic stratum $6-10\ \mu$ deep. In pale-coloured specimens there is no distinct cortex. Gonidial algae tend to form more or less vertical groups or rows extending through almost whole depth of thallus; bright green, subglobose or irregularly angulose, thin-walled, $6-9\ \mu$ diam. Fungal tissue between gonidia hyaline, paraplectenchymatic, of thin-walled isodiametric cells $3-4\ \mu$ diam. Lowermost $25-30\ \mu$ of thallus is without algae, hyaline, with vertically oblong cells. Perithecia numerous, but not present in all areolae of thallus; 1-4(-5) in an areola, with the convex or almost hemispherical, brown-black, matt or slightly shining apex (involucrum) prominent above the surface and $0.2-0.3$ mm. diam. Thallus not darkened around perithecia. Ostiole usually visible under lens as a fine central pore. Excipulum immersed, globose, $290-345\ \mu$ diam., with colourless wall $30-35\ \mu$ thick formed of tangentially running hyphae $1.5-2.0\ \mu$ thick; at the apex, where it merges into the involucrum, the excipular wall becomes brownish.

¹ The northern extremity of Hughes Bay, in future to be called Cape Sterneck.

Involucrum dome-shaped, lying directly over the excipulum, brown-blackish, of $\pm$ uniform thickness (45–60 μ). Periphyses numerous inside ostiole and upper part of excipulum; their walls gelatinized, only the slender lumina visible, simple or sparingly branched, 30–45 $\times$ 1.5 μ . Usually no paraphyses are present, but in some perithecia there are a few delicate branching hyphae 1.5–5.0 μ thick traversing the mucilage between the asci. Asci clavate or ventricose-clavate, 50–65 $\times$ 20–30 μ , with gelatinous walls up to 5 μ thick. Spores irregularly 2–3-seriate in ascus, 8, with wall about 0.6 μ thick, variable in size and shape, ellipsoid to broadly ellipsoid, (12.5–)14–18(–20) $\times$ (7.0–)8–11(–13) μ . Pycnidia indicated by minute punctations or brownish spots, saccate or almost flask-shaped in section, simple, 180–240 μ deep, 75–90 μ across, with colourless wall, not carbonized around ostiole. Fulcrum exobasidial, subulate. Pycnoconidia bacillar, straight, 3.0–3.5 $\times$ 0.6–0.7 μ .

Chemical reactions: surface of thallus and medulla KHO-, CaCl_2O_2 -, $\text{KHO}(\text{CaCl}_2\text{O}_2)$ -, $\text{C}_6\text{H}_4(\text{NH}_2)_2$ -, I-. Hymenial mucilage I+ wine-red, ascus-contents and spores yellowed.

Vainio's '*Verrucaria glaucoplaca*' represents an uncommon growth-form of the species, for which reason I prefer to use '*elaeoplaca*' as the specific epithet, the type specimen of the latter being the normal state. The designation *V. elaeoplaca* f. *glaucoplaca* (Vain.) M. Lamb, n. comb., may be used for the form, occasionally met with in damper situations, in which the thallus is composed of a number of separate, contiguous, juvenile and uncracked thalli separated by dark brown lines, giving the impression of a thallus consisting of large dark-edged areolae. This is well shown on Vainio's pl. i, fig. 5. The F.I.D.S. specimen no. 1801 from Goudier Islet is partly referable to this form.

In very wet situations the thallus is more continuous (the cracks not usually anastomosing to form complete areolae) and usually with a pronounced red or pink tinge. In a fresh-water pool in the penguin rookery at Hope Bay I was able to trace the transition from the normal brown areolate condition on stones on the upper drier banks of the pool to the reddish more continuous state in the pool itself.

V. elaeoplaca is very characteristic of inundation surfaces wetted by nitrogenous snowmelt water in springtime. The photographs on Pl. III, figs. 1 and 2, were taken on Goudier Islet. In fig. 1 it is seen lining a natural gutter in the granodiorite rocks down which a steady seepage of water occurs during the melting of the islet's snow cover. Fig. 2 shows it forming a zone around the margin of a snowmelt water pool, and also bordering the run-off channel from the latter. The snowmelt water is highly nitrogenous from the excreta of birds (gulls, skuas, *Chionis alba*, etc.). Although the species is restricted so closely to inundation surfaces, the duration of actual inundation during the year is comparatively short, lasting from late October, when the snow accumulated during the winter commences to melt, till about the end of November, when in normal years the upper part of the islet should have become snowfree.

GEOGRAPHICAL DISTRIBUTION. Apparently endemic to the coast of Graham Land and adjacent islands. Previously recorded from west Graham Land: Palmer Archipelago, Moreno Island, Bob Islet (Vainio, loc. cit.) and Goudier Islet (Hue, loc. cit.).

Verrucaria famelica Darbishire (Fig. 3f; Pl. IV, fig. 3)

1912, p. 18, pl. 3, fig. 33.

Not found in the present collections. Known only from the type locality: South Shetlands, Nelson Island, coll. C. Skottsberg, 11. i. 1902. The following redescription of the species is based on a syntype specimen preserved in the Kew Herbarium.

On non-calcareous fine-grained rock. Thallus interruptedly covering an area of 2.5 $\times$ 2.0 cm., brown-blackish, thin (up to 0.1 mm. thick), effuse, indeterminate, not continuous, but composed of small confluent patches around the perithecia, with the substratum visible between; continuous or here and there slightly cracked, matt. A very fine blackish dendritic-reticulate hypothallus is visible with

the aid of a $\times 10$ lens here and there around the thalline patches. Thallus in section with very irregular upper surface bounded by a brown-blackish cortical layer $6-8\mu$ thick with indistinct, $\pm$ round cells $3-5\mu$ diam. Most of the fungal tissue between the gonidial algae is also dark. Gonidia extend throughout whole depth of thallus, not in vertical rows; bright green, $\pm$ globose, $5-8(-12)\mu$ diam., thin-walled, multiplying apparently by binary fission. Perithecia up to $0.2(-0.25)$ mm. diam., hemispherical to subglobose, black, matt or slightly shining, clothed by thallus in lower half, or in young perithecia almost to the ostiole. Ostiole apical, minute, not or only slightly impressed. Excipulum $\pm$ globose or slightly flattened, $145-210\mu$ diam., with faintly brownish or almost colourless wall $12-30\mu$ thick composed of compacted, tangentially running hyphae about 2μ thick. Involucrellum overlaying excipulum and extending down to its base, brown-blackish in outer half to three-quarters, paler brown inside; about 30μ thick near ostiole, up to 80μ thick at base, not extending below the excipulum. Periphyses numerous near ostiole, $\pm$ simple, $15-24 \times 1.5-2.0\mu$. Paraphyses soon diffused and evanescent. Asci clavate, $60-65 \times 18-21\mu$, with colourless gelatinous wall up to $4(-5)\mu$ thick. Spores $6-8$, irregularly biserial in ascus, elongate-ellipsoid, the ends rounded or sometimes bluntly pointed, thin-walled, $18-20 \times 7.5-8.0\mu$. With iodine, hymenial gelatine, and sometimes ascus walls also, pale rose-pink; contents of asci and spores yellowed.

This species apparently belongs to the very critical group of *V. aethiobola*.

Verrucaria maura Wahlenberg

apud Acharius, 1803, suppl. p. 19; Vainio, 1903, p. 38; Zschacke, 1934, p. 179.

Not present in our collections; the only antarctic record is that of Vainio, from west Graham Land: Palmer Archipelago, Moreno Island.

GEOGRAPHICAL DISTRIBUTION. A widespread species, occurring on the coasts of Europe, North America, Greenland, Iceland, Spitsbergen, Bear Island, Novaya Zemlya, Siberia, Bering Strait, Japan, and, in the southern hemisphere, Fuegia, Patagonia, South Chile, Falkland Islands¹ and New Zealand.

Verrucaria microspora Nylander (Fig. 3h)

1855, p. 175; Zschacke, 1934, p. 195.

Verrucaria microspora f. *halophila* Nylander, 1855, p. 175.

Verrucaria halophila Nylander, apud Branth and Rostrup, 1869, p. 275.

WEST GRAHAM LAND. *Mainland Coast*: Cape Renard; on non-calcareous rocks at about normal high-tide level, constantly drenched by wave action during rough weather, together with *V. mucosa* Wbg.; F.I.D.S., 22. iii. 1944 (no. 1172 *pr. p.*). *Palmer Archipelago*: Port Lockroy, Goudier Islet; south side of islet on granodiorite rocks intermittently submerged by the tide; F.I.D.S., 23. iv. 1944 (no. 1220 *pr. p.*); east side of islet, on lower part of basalt dyke exposed only at low tide; F.I.D.S., 23. iv. 1944 (no. 1228).

SOUTH ORKNEYS. *Fredriksen Island*: on non-calcareous rock; Discovery 1931-3, 4. i. 1933 (nos. 1090-19, 1090-28).

Sporadic and scarce. F.I.D.S. no. 1228 is the typical form, with entirely colourless excipulum; the other specimens belong to the form *frisiaca* (Erichs.) Santesson, 1939, p. 41 (*V. frisiaca* Erichsen, 1930, p. 224), characterized by the somewhat pigmented, brownish excipular wall. Spores $8-12 \times 4-5\mu$.

GEOGRAPHICAL DISTRIBUTION. New to the Antarctic; widely distributed on the coasts of Europe, also recorded from North America (Maine), Greenland, Japan, and Chile.

¹ Collected by me at Port Louis, Berkeley Sound, in Feb. 1946.

Verrucaria mucosa Wahlenberg (Fig. 1c)

apud Acharius, 1803, suppl. p. 23; Zschacke, 1934, p. 192; Santesson, 1939, p. 4.

WEST GRAHAM LAND. *Mainland coast*: Cape Renard; on non-calcareous rocks at about normal high-tide level, constantly drenched by wave action during rough weather; F.I.D.S., 22. iii. 1944 (no. 1172 *pr. p.*).

Quite typical, although poorly developed. Thallus thin, in scattered irregular patches, continuous or with a few sporadic cracks probably due to post mortem drying. Spores $9-13 \times 6-7 \mu$.

GEOGRAPHICAL DISTRIBUTION. New to the Antarctic. Occurs on the Atlantic seaboard of Europe, Iceland, Greenland, North America, Siberia; also in the subantarctic (Fuegia, Auckland Island, Campbell Island); possibly in New Zealand (Santesson, 1939, p. 17).

Verrucaria psychrophila M. Lamb, n.sp. (Fig. 3g; Pl. I, figs. 1, 3)

WEST GRAHAM LAND. *Palmer Archipelago*: Port Lockroy, Goudier Islet; on granodiorite rocks and boulders in the boat harbour and on the south side of the islet, intermittently submerged by the tide; F.I.D.S., 25. iii. 1944 (no. 1178, holotype); 21. iv. 1944 (no. 1219); 23. iv. 1944 (no. 1220).

DESCRIPTION. *Thallus epilithicus, olivaceo-nigricans aut nigricans, madefactus leviter gelatinosus, contiguus, late expansus, effusus, modice incrassatus* ($0.20-0.25$ mm. *crassus*), *laevigatus, vix nitidus, reticulatrimosus vel plerumque grosse areolatus, areolis* $1.0-2.5$ mm. *latis, irregulariter angulosis, planis vel levissime convexis, rimis acutis ad* 0.1 mm. *latis separatis; ad peripheriam tenuior, anguste pallidus (olivaceo-albidus), hypothallomullo; stratum basale thalli haud fuliginosum. Gonidia laete vel flavidoviridia, 8-15 (-20) μ diam., in seriebus verticalibus disposita. Perithecia numerosa, in quavis areola 2-20, immersa, apice atro, haud vel paullum nitido, subconvexo, 0.1-0.2 mm. lato leviter emergenti; ostiolo nec papillato nec impresso, indistincto. Excipulum globosum aut depresso-globosum, 165-180 μ diam., omnino incoloratum, superne involucrello carbonaceo-fuligineo, lateribus leviter producto, 20-40 μ crasso, 210-245 μ lato obductum. Paraphyses mox dissolutae. Asci clavati, 40-50 $\times$ 12-18 μ , pariete aequaliter tenui. Sporae 8nae, in asco irregulariter biseriatim dispositae, simplices, incolores, ellipsoideae, 11-13 (-15) $\times$ 6-7 μ . Pycnidia numerosa, peritheciis intermixta, maculis punctiformibus atris circ. 0.05 mm. diam. indicata, haud prominentia; pycnoconidia bacillaria, recta aut rarius leviter curvata, 3-4 $\times$ 0.6-0.7 μ . Thallus extus intusque KHO-, CaCl_2O_2 -, $\text{C}_6\text{H}_4(\text{NH}_2)_2$ -, I-; gelatina hymenialis I+ leviter roseo-rubescens vel-, ascis sporisque lutescentibus, strato ascigero pallide caerulescenti.*

The thallus has a rudimentary brown or olive-brown cortex $7-12 \mu$ deep, formed from the pigmented, concrete ends of the vertical thalline hyphae; the cells are thin-walled, $3.0-4.5 \mu$ diam. The gonidial algae occupy the entire depth of the thallus, but are more concentrated and larger in the upper half; arranged in distinct vertical rows; bright green in living material, subglobose or irregularly angulose, often $\pm$ horizontally flattened, thin-walled, multiplying by fission into 2's, 4's and 8's. Fungal tissue between algae colourless, hyaline, compact, entirely paraplectenchymatic, with oblong, upright, or $\pm$ cubical thin-walled cells $3.0-4.5 \times 2.5-3.0 \mu$. Excipulum colourless, of even thickness all round ($18-30 \mu$), formed of tangentially elongated thin-walled cells. Involucrellum brown-black, slightly convex, about 20μ thick round ostiole, $35-40 \mu$ thick at margin. Periphyses crowded on upper inner wall of excipulum, simple, $12-30 \times 1.5-2.5 \mu$. Spores thin-walled, often with granulose contents but no large guttules. Pycnidia globose or flask-shaped, $75-120 \mu$ across, $100(-300) \mu$ deep, with colourless perifulcrum; ostiole surrounded by brown-black tissue like a small involucrellum. Fulcra exobasidial, subulate.

This species appears to be related to *V. ceuthocarpa*, from which it differs in the much larger thallus-areolae, extensive growth-habitus, and somewhat longer spores. From *V. tesselatula* Nyl. it is distinguished by the blackish, more regular areolae without darker edges. It is also ecologically distinct from

these two species, occurring at a low level in the littoral zone which would correspond in the Northern hemisphere to the *Fucus vesiculosus*-*Balanus* belt.

Owing to the pronounced irregularity of the tides at Port Lockroy (they are seasonal rather than diurnal) it is impossible to fix the position of the lichen in terms of 'high' or 'low' tide marks, and difficult to assess the relative degrees of submergence and exposure. A series of observations was made from 22 April to 24 May 1944; during this period exposure was noted only on 20, 21 and 22 May, for a few hours daily. Towards the end of May the boat harbour froze over for the winter, and on subsequent occasions, when the tide ebbed out sufficiently far to expose the lichen, the latter remained covered by the ice layer. By the beginning of July the ice covering it was up to 75 cm. thick. After the break up of the ice in late October a prolonged period of abnormally low spring tides set in, and the lichen was regularly exposed for several hours each day.

In the summer months *V. psychrophila* is most conspicuous on the boulders in the boat harbour of Goudier Islet, blackening them with what looks from a distance like a sooty coating (Pl. I, fig. 1). Seen from close quarters the colour is greenish blackish or olive-blackish (Ridgway, 1912, p. xlvii, 25''' m, pl. li, 23''' m). It also occurs on the solid rock at the other (southern) side of the islet, at the same level. In its vertical distribution it is restricted to the hydrohaline and does not appear to overlap either the lower zone of the permanently submerged *V. serpuloides* or that of the upper spray-zone species (*V. ceuthocarpa*). The brown alga *Adenocystis utricularis* occurs at the extreme base of its vertical range.

Santesson (1939) has pointed out that the degree of cracking in the thallus of the marine *Verrucariae* is to some extent connected with the degree of submersion to which they are subject. The specimens of *V. psychrophila* which I collected from the south side of Goudier Islet (no. 1220) have a much less cracked thallus than those from the boat harbour; the cracks are more sporadic, not joining up to delimit distinct areolae. Although the vertical horizon is the same, it is possible that the lichen in this relatively exposed position is more constantly wetted by wave action.

As in several other marine *Verrucariae*, the thallus becomes brown after some time in the herbarium.

***Verrucaria Racovitzae* Vainio (Fig. 3a; Pl. IV, fig. 2)**

1903, p. 38; Darbshire, 1923, p. 106.

Not present in our collections. It occurs in west Graham Land: Palmer Archipelago, Moreno Island (Vainio, loc. cit.), and also, *fide* Darbshire (loc. cit), on Elephant Island in the South Shetlands. I have not seen Darbshire's specimen.

The holotype specimen in herb. Vainio (Exped. Antarct. Belge, no. 196 *pr. p.*) is shown on Pl. IV, fig. 2. It is a small fragment of thallus about 1 cm. across, occurring together with *V. elaeoplaca* f. *glauco-placa*, on fine-grained non-calcareous rock. Thallus 0.1–0.2 mm. thick between the perithecia, rimose or in places subcontinuous, the cracks (up to 0.1 mm. wide) occasionally reticulating to delimit irregularly angulose areolae 0.5–1.4 mm. diam.; olivaceous-glaucous or buff-coloured, i.e. approximately the same colour as the thallus of *V. elaeoplaca*, not changing when moistened; surface smooth, matt, not pruinose. A black hypothallus is visible in cross section, underlying the thallus. Cortex present, pale brown or almost colourless, 9–14 μ deep, of $\pm$ isodiametric, thin-walled cells 2–3 μ diam. The whole depth of the thallus above the basal carbonaceous layer is filled with gonidial algae, which are irregularly scattered, bright green, globose or angular, 8–11 μ diam., thin-walled. Fungal tissue between algae hyaline, paraplectenchymatic, of thin-walled cells 2–3 μ diam. Perithecia numerous, clothed by thallus almost to ostiole, forming hemispherical verrucae 0.7–0.9 mm. diam., with dark brown or blackish circular apex 0.2–0.3 mm. diam., slightly mamillate, with minute central pore. The thallus clothing the perithecia contains a thin layer of gonidia. Excipulum globose or upright-oval in

section, about $450\ \mu$ diam., with entirely brown-blackish wall $25\text{--}35\ \mu$ thick, and covered to the base by a massive carbonaceous involucrellum $75\text{--}100\ \mu$ thick which fuses with the hypothalline tissue below. Periphyses indistinct. No paraphyses. Asci clavate, $50\text{--}65 \times 12\text{--}20\ \mu$, with colourless gelatinous walls up to $5\ \mu$ thick. Spores 8, irregularly biserial in ascus, with granulose contents and wall about $0.7\ \mu$ thick, ellipsoid or occasionally broadly ellipsoid, $15.0\text{--}16.5 \times 9\text{--}11\ \mu$. Pycnidia indicated externally by non-prominent, black, round or slightly elongated, ring-like spots about $0.15\ \text{mm. diam.}$; compound, consisting of several flattened intercommunicating chambers with colourless walls $6\text{--}9\ \mu$ thick; ostiole surrounded by carbonaceous tissue. Fulcra exobasidial, simple. Pycnoconidia bacillar, straight, $3.0\text{--}3.5 \times$ about $0.7\ \mu$.

Chemical reactions: surface of thallus and medulla KHO- (or brownish), CaCl_2O_2 -, $\text{KHO}(\text{CaCl}_2\text{O}_2)$ -, $\text{C}_6\text{H}_4(\text{NH}_2)_2$ -. Hymenial gelatine pale wine-red with iodine.

V. Racovitzae belongs to the section *Lithoidea* and appears to be related to *V. cataleptoides* Nyl.

Verrucaria serpuloides M. Lamb, n.sp. (Fig. 3e; Pl. I, fig. 2; Pl. II, fig. 1; Pl. IV, fig. 8)

WEST GRAHAM LAND. *Palmer Archipelago*: Port Lockroy, Goudier Islet; on granodiorite rocks west of the boat harbour, below the level of the lowest spring tides and therefore permanently submerged; F.I.D.S., 27. viii. 1944 (no. 1250 *pr. p.*); 19. x. 1944 (nos. 1321, 1322).

EAST GRAHAM LAND. *Trinity Peninsula, south coast*: Hope Bay; in rock pool just below low-water mark on occasion of low spring tides; F.I.D.S., 21. xi. 1945 (no. 2565, holotype).

DESCRIPTION. *Thallus epilithicus, piceo-niger (partibus tenuibus olivaceo-nigricans), effusus, uniformis, substratum late tegens, contiguus, ad 0.5 mm. crassus, ambitu tenuior et haud zonato-circumscriptus; continuus, laevigatus, subnitidus, statu madefacto sat gelatinosus, strato basali haud fuliginoso; gonidia laete viridia, globosa compressave, 6-10(-12) μ diam., seriebus verticalibus per totam crassitudinem thalli disposita. Perithecia sat numerosa, sparsa, thallo immersa, apice (involucrello) bene prominenti, tumido-annulari vel truncato-subconico, atro, saepe nitido, 0.30-0.45 mm. diam., superne primo planiusculo, demum concavo-impresso; poro centrali semper conspicuo, 0.03-0.06 mm. lato. Excipulum globosum, 300-435 μ diam., 30-45 μ crassum, basi lateribusque incoloratum, superne cum involucrello carbonaceo, 60-115 μ crasso, extrorsum haud producto confluent. Paraphyses nullae. Asci clavati aut ventricosi-clavati, membrana gelatinoso-incrassata, vix visibili, 3-7 μ crassa, cavitate plasmophora $40\text{--}50 \times 12\text{--}18\ \mu$. Sporae 6-8nae, in asco subbiserialae, simplices, incolores, ellipsoideae vel late ellipsoideae, membrana sat tenui (ad $0.7\ \mu$), $(13\text{--})14.0\text{--}15.5 \times 8\text{--}10\ \mu$. Pycnidia sparsa, extus haud vel vix visibilia, omnino immersa, ostiolo haud carbonaceo; pycnoconidia bacillaria, recta, $5\text{--}7 \times$ circ. $1.5\ \mu$. Thallus extus intusque KHO-, CaCl_2O_2 -, $\text{C}_6\text{H}_4(\text{NH}_2)_2$ -, I-; gelatina hymenialis I+ subtilissime rosea vel-, parietibus ascorum immutatis, sporis fulvescentibus.*

Thallus in section has a slightly developed light brown cortical layer up to $10\ \mu$ thick, formed from the end cells of the vertically fused thalline hyphae; cells thin-walled, $3\text{--}4\ \mu$ diam. Gonidial algae in well-marked vertical rows, larger and more crowded in upper $60\text{--}90\ \mu$ of thallus, often slightly horizontally flattened, multiplying apparently by binary fission. Medullary tissue hyaline, para-plectenchymatic, of $\pm$ cubical thin-walled cells $3\text{--}5\ \mu$ diam. No dark hypothalline tissue present. Excipulum formed of tangentially running compacted hyphae about $2\ \mu$ thick. Periphyses well developed on upper inner side of excipulum round the ostiole; embedded in hyaline mucilage, simple or sparingly branched, $30\text{--}45 \times 1.5\text{--}2.5\ \mu$. Asci spring from both base and sides of excipulum; the outlines of their swollen and highly gelatinized walls can be distinguished only after treatment with iodine, which tints the surrounding mucilage $\pm$ rose pink. The spores often contain a single moderate guttule. Pycnidia irregularly flask-shaped, about $60\ \mu$ across, $150\ \mu$ deep. Perifulcrum colourless. Fulcra exobasidial, simple, subulate, $12\text{--}20 \times 1.5\text{--}2.0\ \mu$.

Quite distinct from *V. mucosa*, the only species with which it may be said to have any affinity, by the much larger and prominent perithecia. It is of interest in being the only known marine lichen which passes its entire existence under water. *V. mucosa*, hitherto regarded as the most truly marine of all lichens, does not tolerate constant submersion; see in this connexion the remarks of Santesson (1939).

V. serpuloides occurs at the same level as an encrusting calcareous alga (*Lithophyllum* sp.?), and forms with it a submarine association just below the lowest ebb-tide level. During the exceptionally low spring tides at Port Lockroy on 2 and 3 November 1944, some of the uppermost patches of the calcareous alga-*Verrucaria serpuloides*-association were exposed for a short period¹, but at the most extreme ebb I could see the association running down on shelving rocks to a depth of several feet below the surface, where it is certainly never exposed (Pl. I, fig. 2). One also finds the association in rock pools left by the receding tide, both the calcareous alga and the *Verrucaria* consistently keeping below the water level. This is shown in the underwater photograph Pl. II, fig. 1, in which the *Verrucaria* is seen as a black band the upper edge of which coincides exactly with the surface of the water in the pool when the latter is left at ebb tide. This clear-cut upper limit is an indication that the submarine habitat in *V. serpuloides* is obligatory and not facultative.

Verrucaria tessellatula Nylander (Fig. 3d; Pl. IV, fig. 9)

apud Crombie, 1876, p. 191; Müller (Arg.), 1889, p. 172.

Verrucaria dermoplaca Nylander, apud Crombie, 1876a, p. 234 (vide infra).

Verrucaria glaucoplacoides Darbishire, 1912, p. 18, pl. 3, figs. 34, 35; Cengia Sambo, 1926, p. 23.

SOUTH ORKNEYS. *Inaccessible Islands*: on schistose rock (non-calcareous); Discovery 1931-3, 25. i. 1933 (nos. 1094-1, 1094-2).

Comparison of the holotype of Darbishire's *V. glaucoplacoides* from East Falkland with a syntype of Nylander's *V. tessellatula* from Kerguelen (in herb. Kew) showed them to be identical. This species is closely related to *V. ceuthocarpa*, from which it differs in the lighter coloured thallus with larger areolae separated by gaping black cracks. Darbishire's photographs (loc. cit) show the habitus well. The following data are derived from the syntype specimen from Swain's Bay, Kerguelen, coll. Transit of Venus Expedition, 1874-5.

Thallus 0.15-0.20 mm. thick, even, tessellate-areolate with plane, angulose areolae 0.5-1.0 mm. diam. separated by conspicuous black cracks about 0.15 mm. wide; matt, not pruinose, pale buff-brown. No basal fuliginous layer. Gonidial algae subglobose, 9-15 μ diam., with a slight tendency to form vertical rows in the thallus; $\pm$ bright green, multiplying by binary fission, so that two are often seen together in the same sheath, as mentioned by Nylander. Perithecia numerous, 1-6 in an areola, up to 0.2 mm. diam., with the black convex apex (involucrellum) rising slightly above thallus level, matt or slightly shining, not impressed or papillate, with very minute ostiole. Excipulum globose, immersed, 165-180 μ diam., with colourless wall. The involucrellum, brown-blackish in section, forms a dome-like roof over the upper part of the excipulum. No paraphyses. Asci clavate, about $40 \times 12 \mu$, with indistinct gelatinized walls. Spores about $11 \times 7 \mu$ (10-15 $\times$ 7-8 μ according to Nylander).

The specimens from East Falkland agree well with the Kerguelen type. The specimen from Tierra del Fuego, Ushuaia, coll. Dusén, distributed in 'Lichenes austroamerici ex Herbario Regnelliano', no. 377, and also one of the South Orkneys specimens (no. 1094-1) have in places more isolated and less reticulating cracks, leaving small areas of the thallus continuous and unbroken; they show the first stages of a transition into the extreme state in which the thallus is not areolate, but divided by a loose and irregular network of rhagadiose black-edged cracks into irregular islands of various size.

¹ The parts of the calcareous alga thus exposed subsequently died.

This state was described by Nylander on material from Fox Bay in West Falkland as '*Verrucaria dermoplaca*' and for practical purposes may be distinguished as *V. tessulatula* f. *dermoplaca* (Nyl.) M. Lamb, n.comb. The South Orkneys specimen no. 1094-2 belongs to this form.

Apart from these differences in external habitus, the variability of this species is not great. The thallus varies in colour from pale glaucescent buff (Ridgway, 1912, pl. xl, 19'''b) to a pinkish brown (pl. xlv, 13'''i), usually yellowish buff or brown-buff (pl. xl, 17'''h). Upper cortex present: brown, 9-15 μ deep, composed of $\pm$ rounded, thin-walled cells 3.0-4.5 μ diam. Fungal tissue between gonidial algae hyaline, paraplectenchymatic. Perithecia up to 0.25 mm. diam., varying on the same thallus from slightly convex-emergent to hemispherical. Excipulum variable in size, 165-270(-300) μ diam., always with hyaline wall at base and sides. Usually there is no trace of paraphyses, but occasionally a few isolated hyphae are present in the mucilage around the asci. Asci up to 50 $\times$ 20 μ , with diaphanous gelatinized walls up to 5 μ thick. Spores 11-15 $\times$ 6.5-9.0 μ . Hymenial gelatine rose-pink with iodine.

V. tessulatula, like the related *V. ceuthocarpa*, is a marine species of the spray zone. I saw it at Port Louis, East Falkland, forming extensive patches on shoreline rocks 0.5-1.0 m. above high-water level, associated with *V. maura*. The South Orkneys specimens occur together with *Caloplaca cirrochrooides* (Vain.) Zahlbr., which is also a species characteristic of the upper spray zone.

GEOGRAPHICAL DISTRIBUTION. Subantarctic-antarctic, perhaps circumpolar; Kerguelen, Falklands, Fuegia, South Orkneys.

Verrucaria sp.

SOUTH ORKNEYS. *Inaccessible Islands*: on schistose rock, together with *V. tessulatula* Nyl.; Discovery 1931-3, 25. i. 1933 (no. 1094-2 *pr. p.*).

A small patch of olive-blackish, rimose, minutely black-punctate thallus. Unfortunately, no mature perithecia are present. The thallus indicates that it belongs to the *atricola-aractina-Erichsenii-scotina-Zschackeana* group, none of which have as far as I know been recorded from the southern hemisphere.

EXCLUDED SPECIES

Verrucaria exquisita Darbishire, 1912, p. 17.

Re-examining the type material from South Georgia, I found it to be *Lecidea Dicksonii* (Gmel.) Ach. in a very poorly developed condition, with minute juvenile apothecia about 0.1 mm. in diameter, in their unexpanded state resembling perithecia. The upper part of the thecium was characteristically aeruginose, and two spores were seen, 10-12 $\times$ 5-7 μ .

Genus *Thelidium* Massalonge, 1855

Three species attributed to this genus were found in Marie Byrd Land by the second Byrd Antarctic Expedition, and described by Dodge and Baker (1938). One of them, *Th. Caloplacae* Dodge and Baker, is a lichen-parasite with numerous spores in the ascus, and should hence be excluded from the genus. The others, *Th. inaequale* Dodge and Baker, p. 524, pl. 38, figs. 1-5, and *Th. parvum* Dodge and Baker, p. 526, pl. 62, figs. 393-395, the first occurring on schistose rocks and the second over the thallus of a *Parmelia* on sandy loam, show some spore characters unusual in this genus. In *Thelidium inaequale* the spores are dark coloured, 1-septate with frequently unequal cells, 10-13 $\times$ 5-7 μ ; in *Th. parvum* colourless, 1-septate with unequal cells, 7.5-9.0 $\times$ 3.0-3.5 μ . The thallus in both these species is extremely reduced or evanescent, and the perithecia are of simple structure with entire dark walls of only a few cell layers in thickness.

Genus *Staurothele* Norman

1853, p. 240.

Staurothele gelida (Hook. f. and Tayl.) M. Lamb, n.comb. (Fig. 3j, k)*Verrucaria gelida* Hooker and Taylor, 1844, p. 639.'*Verrucaria umbrina*' in Hooker, 1845-7, p. 541, pl. cxcviii, fig. iv (non Wahlenberg).*Verrucaria umbrina* var. *monospora* Nylander, 1855, p. 175.*Verrucaria monospora* Malme, 1928, p. 9.

WEST GRAHAM LAND. *Palmer Archipelago*: Port Lockroy, Goudier Islet; near summit of islet, altitude *c.* 7 m., on vertical south-facing side of basalt dyke; F.I.D.S., 28. xii. 1944 (no. 2125); near summit of islet, on old limpet shells; F.I.D.S., 28. xii. 1944 (no. 2101). *Argentine and neighbouring Islands*: Berthelot Islands; on north-facing inland cliff (non-calcareous); B.G.L.E., 18. iii. 1935 (nos. 1081-32, 1094-91).

EAST GRAHAM LAND. *Crown Prince Gustav Channel*: Station 30; west side of island, on agglomerate rocks in slope just above sea-level; F.I.D.S., 12. xi. 1945 (no. 2841 *pr. p.*). Corry Island¹; on agglomerate outcrop near sea-level at foot of scree slope; F.I.D.S., 17. xi. 1945 (no. 2835 *pr. p.*). Persson Island; north-west shore, at sea-level, on non-calcareous stones; F.I.D.S., 21. xii. 1945 (nos. 2663, 2664). *James Ross Island*: St. 51; altitude *c.* 60 m., on basaltic stones irrigated in summer by snowmelt water; F.I.D.S., 23. xi. 1945 (nos. 2640, 2641 *pr. p.*, 2642 *pr. p.*). Cape Lachmann; altitude *c.* 30 m., on non-calcareous stones near a fresh-water pond; F.I.D.S., 21. xi. 1945 (no. 2673); altitude *c.* 60 m., on basaltic rock; F.I.D.S., 21. xi. 1945 (no. 2781). *Seymour Island*: western slopes of plateau in north part of island, altitude *c.* 150 m., on a calcareous stone; F.I.D.S., 30. viii. 1945 (no. 2477 *pr. p.*).

Like *St. clopima* (Wbg.) Th. Fr., but spores constantly single in ascus and usually larger than in *St. clopima*: (45-)60-75 × (15-)21-32 μ (or up to 90 μ long, in Argentine specimens according to Malme, loc. cit.).

The holotype of '*Verrucaria gelida*' from Cockburn Island in the Erebus and Terror Gulf was located in the herbarium of Churchill Babington, now in the British Museum. In outward appearance it is quite similar to *Staurothele clopima*, and like that species has bacilliform hymenial gonidia. Single-spored asci are occasionally met with in *St. clopima*, but the uniformity of the character in all our Antarctic material seems to justify the specific separation suggested by Malme.

In external morphology the range of variation is like that of *St. clopima*, that is to say, large. The thallus may be reduced and scanty, consisting of a thin crust between the perithecial warts (as in the Cockburn Island holotype) or up to 1 mm. thick and verrucose-areolate. In the former case a ring of gonidia-bearing thallus tissue is often carried up and isolated on the sides of the perithecium (Fig. 1j). The colour of the thallus varies with exposure, from a medium brown (Ridgway, 1912, pl. xlvi, 13''' k) in shaded south-facing positions, to brown-black (Ridgway, pl. xlvi, 17''' n) in some cases on exposed stones (no. 2673). The excipulum is more or less globose, variable in size (200-300 μ diam.), colourless or almost so when young, but becoming increasingly brown with age, until, in old perithecia, it consists entirely of dark brown tissue hardly distinguishable from the apical brown-blackish involucrellum. The hymenial gonidia are cubical to bacillar, 3-9 × 2.5-3.0 μ, pale green. Thalline gonidia bright green, ± globose, thin-walled, 6.0-10.5 μ diam.

Hooker's illustration in the *Flora Antarctica* shows the single spores still enclosed in the ascus.

Like *St. clopima*, *St. gelida* is particularly characteristic of positions seasonally inundated by fresh-water rivulets, in this case derived from the melting of snow and ice. One finds it on lowlying ground with good snow cover throughout the winter, and where during the heavy thaws of spring and early summer it leads a purely aquatic existence. Its maximal development was seen on James Ross Island

¹ Formerly Cape Corry.

(no. 2640), where it formed a conspicuous association on flat stones lying in extensive rivulets and seepage areas derived from an ice cap higher up.

GEOGRAPHICAL DISTRIBUTION. Outside the Graham Land sector of the Antarctic, this species is known from Argentina and Chile. It and *St. clopima* are perhaps bipolar-vicarious species.

Genus *Microglaena* Körber, 1855

Microglaena antarctica M. Lamb, n.sp. (Fig. 3*p*; Pl. IV, fig. 5)

SOUTH SHETLANDS. *Nelson Island*: Harmony Cove, on fine-grained non-calcareous rock; Discovery 1933-5, 14. xii. 1934 (nos. 1480-1, 1480-2, the latter the holotype). *Deception Island*: east coast, by Ringed Penguin rookery, on agglomerate rock; B.G.L.E., 16. i. 1936 (no. 1381-3); tuff cliffs above main Ringed Penguin rookery, altitude *c.* 140 m.; B.G.L.E., 20. i. 1936 (nos. 1399-4, 1400-13, 1400-38); south-west side of 'Neptune's Bellows', on weathered agglomerate crags with fair shelter; Discovery 1933-5, 10. i. 1935 (nos. 1488-1, 1488-2 *pr. p.*). *Desolation Island*: on non-calcareous rocks in gull rookery, altitude *c.* 20 m.; Discovery 1933-5, 8. i. 1935 (no. 1487-6).

DESCRIPTION. *Thallus crustaceus, uniformis, plagulas irregulares* 0.4-2.5 centim. *latus inter alios lichenes formans, primo areolatus, mox verrucoso-areolatus aut congeste verrucosus, ad 1(-2) mm. crassus, albidus vel impure albidus vel sordide eburneus, opacus, epruinosis; areolae seu verrucae* 0.3-1.0 mm. diam., *rotundatae angulosaeve, planae aut convexae, saepe convoluto-tuberculatae. Hypothallus nullus distinctus; soredia et isidia desunt. Gonidia cystococcoidea, globosa, 4.5-15.0 μ diam., pallide aut sat laete viridia, pariete tenui. Perithecia singulatim verrucis thallinis 0.5-1.0 mm. latis insidentia, thallo obducta, apice denudato fusconigricanti, ostiolo punctiformi, minuto, saepe leviter papillato. Excipulum immersum, globosum, 450-520 μ diam., omnino incoloratum, superne involucrello fusconigricanti, lateribus haud vel parum producto obtectum. Paraphyses persistentes, filiformes, haud ramoso-connexae, 1.0-1.5 μ crassae, sinuosae, in aqua facile separandae. Asci clavati, 135-210 $\times$ 30-40 μ , pariete incolorato 3.0-7.5 μ crasso. Sporae 4-7(rarius 8)nae in asco, uni- aut partim biseriatim dispositae, oblongo-ellipsoideae aut ellipsoideo-fusiformae, muriformi-cellulosae (cellulis numerosis cuboideis), incoloratae vel levissime infuscatae, halone nullo indutae, formam magnitudinemque haud paullum variantes, 42-90 $\times$ 13-35 μ , plerumque circ. 60 $\times$ 25 μ . Pycnidia verrucis thallinis immersa, ostiolo nigricanti punctiformi 0.1-0.3 mm. diam.; pycnoconidia filiformia, curvata rectave, 15-24 $\times$ 0.6-0.8 μ . Thallus extus et intus KHO- vel sordide flavofuscescens, CaCl_2O_2 -, $\text{C}_6\text{H}_4(\text{NH}_2)_2$ -, I-; sporae plasmaque ascorum I+ rubrofulvescentes.*

There is no basal hypothalline layer, the thallus being attached to the substratum by the hyphae of the lower medulla. Thallus corticate; cortex colourless, 15-34 μ thick, of $\pm$ rounded, thin-walled cells 2.5-5.0 μ diam., in places crushed and indistinct. Gonidial stratum 60-250 μ deep, sometimes entirely filling the verrucose areolae; the algae in the lower parts of the thallus are often dead and brown. Medulla colourless, hyaline, composed of much branched and intricate hyphae 1.5-3.0 μ thick. The brown-black apex (involucrellum) of the perithecia is 0.2-0.5 mm. diam., matt or shining, with central, often lighter coloured ostiole. Excipulum colourless or with a faint yellowish tinge, formed of compacted tangentially running hyphae about 1 μ thick. Involucrellum consists of dark-walled cells 3-5 μ diam., merging $\pm$ gradually into the surrounding colourless tissue. No hymenial gonidia. Paraphyses about the same length as the asci, not capitate; septa visible after treatment with KHO, HCl and I, 9-18 μ apart. Walls of asci not laminated, I-, with a thinner spot at the apex. Pycnidial fulcra exobasidial, simple, 9-13 $\times$ 1.0-1.5 μ .

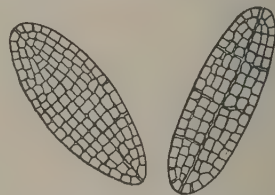


Fig. 4. *Microglaena antarctica* M. Lamb. Spores.

Perhaps related to *M. subluridella* (Vain.) Zahlbr. (Brazil), but differing in the much thicker, verrucose, lighter coloured thallus, larger fertile verrucae, and larger spores. From the f. *terrestris* (Hue) Zahlbr. of *M. muscorum* (Fr.) Th. Fr. it is distinguished by the thicker thallus, colourless excipulum, number of spores in the ascus, and saxicolous habitat.

M. antarctica grows in small patches among other crustaceous lichens (*Caloplaca*, *Buellia*, etc.), and appears to be a rather ornithocoprophilous species.

Family DERMATOCARPACEAE

Genus *Dermatocarpon* Eschweiler, 1824

Section *Endopyrenium* Stizenberger

Dermatocarpon lachneum (Acharius) A. L. Smith (Fig. 3*n*)

1911, p. 270, pl. 37; Vainio, 1921, p. 18; Lynge, 1928, p. 37.

Lichen lachneus Acharius, 1798, p. 140.

Dermatocarpon hepaticum var. *lachneum* Zahlbruckner, 1921, p. 217; Zschacke, 1934, p. 605.

Endocarpon rufescens Acharius, 1810, p. 304.

Dermatocarpon rufescens Th. Fr., 1861, p. 354; Zschacke, 1934, p. 602.

EAST GRAHAM LAND. *Crown Prince Gustav Channel*: St. 28; west side of island, altitude *c.* 25 m., on sandy detritus on ledges in agglomerate cliffs; F.I.D.S., 16. xi. 1945 (no. 2792). St. 29; summit plateau of island, altitude *c.* 130 m., on detritus between rocks and stones; F.I.D.S., 13. xi. 1945 (no. 2828).

The reddish brown squamules are 2–8 mm. across, becoming at maturity contiguous and variously lobate, slightly concave and with conspicuously raised margins, which are for the most part eroded and grey-whitish where the tissue has been killed off by exposure. Most of the black spots on the upper surface are pycnidia, but a few perithecia are present; immersed, pyriform, up to 225 μ across and 360 μ deep, with faintly pink excipular wall. Involucrellum almost obsolete, dome-shaped, dark brown in section, merging at the sides into the thalline cortex. No paraphyses. Asci cylindrical, with bluntly pointed ends, 80–115 $\times$ 9–15 μ , with gelatinous wall about 3 μ thick, becoming thinner at maturity. Spores 8, uniseriate in ascus, ellipsoid, 13.5–18.0 $\times$ 6.0–8.5 μ . Mucilage of hymenium faintly pink with iodine. Pycnidia immersed, globose, up to 330 (–480) μ diam., without distinct wall, filled with spongy canaliculate sporogenous tissue consisting of the massed endobasidial fulcra; pycnoconidia bacillar, 4 $\times$ 1 μ .

One of the few lichens which were present on the bleak summit plateau of St. 29, where there can be no protecting snow cover during the winter on account of the completely exposed situation. It is hardly surprising, therefore, to find necrosis of the raised margins of the squamules, due probably to the eroding action of wind-blown powder snow, which can act like a sandblast in these regions.

GEOGRAPHICAL DISTRIBUTION. New to the Antarctic. A widely distributed species in the northern hemisphere, where it has a very broad range of latitude: North Africa, the Ukraine, southern, central and northern Europe, Iceland, North America from New Mexico to New England, and the Arctic (Greenland, Spitsbergen, and Novaya Zemlya). It has also been recorded from northern India. I do not know of any previous record from the southern hemisphere, but the closely related *D. hepaticum* has been recorded from Western Australia and New Zealand by Müller Arg., and it is possible that some of the material may refer to the present species.

Section *Entosthelia* (Wallroth) Stizenberger*Dermatocarpon intestiniforme* (Körber) Hasse (Fig. 10)

1912, p. 46.

Endocarpon intestiniforme Körber, 1859-65, p. 42.

Dermatocarpon fluviatile var. *decipiens* f. *intestiniformis* Vainio, 1921, p. 13.

'*Lichen polyphyllus*' in Wulfen, 1788, p. 142 (non Linnaeus).

Dermatocarpon polyphyllum Dalla Torre and Sarnthein, 1902, p. 504; Zschacke, 1934, p. 627; Magnusson, 1934, p. 458; Lyngé, 1938, p. 33.

EAST GRAHAM LAND. *James Ross Island*: The Naze; altitude c. 20 m., in a damp shaded overhung crevice in side of agglomerate rock, north-west exposure; F.I.D.S., 26. xi. 1945 (no. 2784).

About 30 thalli, varying in size from 1 to 3 cm. in diameter, were present in the hollow of the rock. They are of the polyphyllous-complicate type, with the lobes mostly convex with downrolled edges. Upper side dull brown, but for the most part covered with a fine caesious-whitish pruina; under side yellowish flesh-coloured to brown, $\pm$ wrinkled but not distinctly veined. The thallus does not become green when wetted. Nearly all the individuals were fertile, but spores were rather sparingly developed, $10.5-12.0 \times 5.0-7.5 \mu$, averaging $11.5 \times 6.3 \mu$.

This species and *D. miniatum* (L.) Mann (var. *complicatum* (Lightf.) Hellb.) are very similar and rather difficult to separate on morphological features. The chief difference is supposed to lie in the spores, which in *D. miniatum* are somewhat longer, 8-14 μ , or even up to 20 μ , according to Lyngé (1938, p. 34). The average length/breadth coefficient is about 1.5 in *D. intestiniforme* and 2.0 in *D. miniatum* (Lamb, 1940, p. 267). In the exsiccata Körber, Lich. sel. German. no. 397, which is authentic material of *D. intestiniforme*, I found spores $8.5-10.5 \times 5.0-6.5 \mu$ with an average length/breadth coefficient of 1.6-1.7. In the Antarctic material the coefficient works out at 1.8. Apparently therefore the difference in spore shape is not a very constant or reliable character, as in both species it fluctuates within rather wide limits. *D. intestiniforme* has a rather typical growth form, implied in the name, and noted by Santesson (apud Lyngé, 1938, p. 34); the edges of the lobes are mostly rolled downwards: 'sehr auffallend sind die darmförmig verschlungenen, zur convexen Areolenform eingerollten mittleren Lappen, doch auch im Umfange ist der Thallus bei aller Verflachung wenigstens an den Rändern meist noch eingerollt' (Körber, loc. cit.).

The specific epithet *polyphyllum* (Wulfen) cannot be used for this species, because Wulfen (loc. cit.) refers to *Lichen polyphyllus* Linn., which is *Umbilicaria polyphylla* (L.) Hoffm.

GEOGRAPHICAL DISTRIBUTION. A bipolar species, new to the southern hemisphere; it occurs in central Europe (where it is alpine), Scandinavia, Iceland and the Arctic (Spitsbergen, Novaya Zemlya, Greenland, Arctic Canada). Lyngé (1938, p. 33) has found *Dermatocarpon intestiniforme* to be a more northern species than *D. miniatum*, which it almost replaces in the Arctic. It has also been recorded from U.S.A.: Arizona and California.

Darbishire, 1910, p. 9, recorded an unnamed species of the genus *Endocarpon* from South Victoria Land: McMurdo Sound, Granite Harbour, collected by the British National Antarctic Expedition of 1901-4. The rock specimen referred to is preserved at the British Museum (Natural History), but no *Pyrenocarp* lichen appears to be now present on it.

Family MASTODIACEAE

Genus *Mastodia* Hooker f. and Harvey, 1847

Mastodia tessellata (Hooker f. and Harvey) Hooker f. and Harvey (Fig. 3 m; Pl. III, fig. 1; Pl. IV, fig. 1)

apud Hooker, 1847, p. 499, pl. cxciv, fig. ii; Vainio, 1903, p. 36, pl. iv, figs. 33, 34, 1909, p. 156; Hue, 1909, p. 315, figs. 1-5, 1915, p. 13; Darbishire, 1912, p. 41, pl. 3, fig. 36.

Ulvella tessellata Hooker f. and Harvey, 1845, p. 297.

Prasiola tessellata Kützing, 1849, p. 473; Hariot, 1889, p. 29, pl. 2, figs. 1-6; Knebel, 1936, p. 45.

Leptogiopsis complicatula Nylander, 1884, p. 211.

Laestadia prasiolae Winter, 1887, p. 16 (fungus).

Guignardia prasiolae Reed, 1902, p. 150 (fungus).

Dermatomeris Georgica Reinsch, 1890, p. 425.

SOUTH SHETLANDS. *King George Island*: Admiralty Bay, Martel Inlet; on fine-grained non-calcareous rock; Discovery 1933-5, 18. xii. 1934 (no. 1481-15); Esther Harbour, east side, slightly above sea-level; Discovery 1935-7, 6. i. 1937 (no. 1949-3). *Deception Island*: north side of crater to west of the whaling settlement, altitude c. 60 m., on andesitic stones on scree slope; F.I.D.S., 8. ii. 1945 (no. 2318 *pr. p.*). *Clarence Island*: Cape Bowles; Discovery 1935-7, 13. xi. 1936 (no. 1874-4).

WEST GRAHAM LAND. *Palmer Archipelago*: Port Lockroy, Goudier Islet; near summit of islet, altitude c. 7 m., on granodiorite rocks; F.I.D.S., 29. ii. 1944 (no. 1151), 28. xi. 1944 (no. 1833), 14. i. 1945 (no. 2234 *pr. p.*), 18. i. 1945 (no. 2256 *pr. p.*); on weathered wooden deck of old whaling scow on beach; F.I.D.S., 1. iv. 1944 (no. 1214). *Mainland coast between Cape Renard and Cape Bellue*: opposite Berthelot Islands; at foot of cliffs, on granitic rock; B.G.L.E., 27. vii. 1935 (no. 1188-1). *Argentine and neighbouring Islands*: Berthelot Islands; on north-facing granitic low sea cliff, altitude 5 m.; B.G.L.E., 18. iii. 1935 (nos. 1094-34, 1094-45). Galindez Island; on non-calcareous rock; B.G.L.E., 23. xi. 1935 (no. 1263-2). *Trinity Peninsula, north coast*: Cape Roquemaurel; on north-east-facing non-calcareous rocks, altitude 16 m.; Discovery 1933-5, 20. i. 1935 (no. 1490-2).

EAST GRAHAM LAND. *Trinity Peninsula, south coast*: Hope Bay; near Boeckella Lake, altitude c. 60 m., on non-calcareous rocks and stones; F.I.D.S., 15. iv. 1945 (nos. 2366, 2368 *pr. p.*, 2369 *pr. p.*, 2372 *pr. p.*); on stones at side of frozen shallow freshwater pool in the penguin rookery; F.I.D.S., 15. iv. 1945 (no. 2363 *pr. p.*).

This organism has been classified by different authors as a lichen, an alga, and a fungus. The algal component is *Prasiola crispa*.

It is the commonest Pyrenocarp lichen in the Graham Land sector of the Antarctic. Skottsberg (1912) has observed its transition into the free-living *Prasiola crispa*, and I saw this also on Goudier Islet. One of the features which speaks most strongly in favour of *Mastodia* being a true lichen is the vigour of the dual organism, and in particular its ability to withstand desiccation better than the free-living *Prasiola*. On Goudier Islet *Mastodia tessellata* covers large areas of the exposed smooth granodiorite rocks, an arid habitat throughout the whole of the summer, except for an occasional light fall of snow or sleet; the plants are nearly always completely dry and brittle to the touch. *Prasiola crispa*, on the other hand, although it can become desiccated for short periods without injury, is much more dependent on a supply of fresh water, and for this reason occurs only in hollows and crevices in the rocks where water tends to flow or accumulate.

Both *Mastodia* and *Prasiola* are highly nitrophilous, occurring in rookeries or on bird-rocks where an abundant supply of nitrogenous matter is available from bird excrement dissolved in snowmelt water. *P. crispa* is one of the most nitrophilous plants known, occurring even around the nests in

penguin rookeries. *Mastodia* avoids such extremely nitrogenous positions. In rock gutters, where a trickle of strongly ammoniacal drainage seeps over periodically from a source higher up, its passage is often intercepted first by a mat of the *Prasiola*, which apparently filters out the most highly concentrated constituents, solid matter, feathers, etc.; the *Mastodia*, often grading into the *Prasiola*, occurs on the side away from the source, thus encountering clearer and presumably less nitrogenous drainage water.

Associated species are *Caloplaca elegans*, *Xanthoria lychnea* (often epiphytic on the *Mastodia*), *Buellia* spp.; *Lecania* (*Thamnolecania*) *Brialmontii* and *Verrucaria elaeoplaca*. The latter species is more hydrophilous, replacing *Mastodia* in the central portions of seepage channels (Pl. III, fig. 1).

M. tessellata has a preference for the harder types of rock (granodiorite, andesite, etc.). On Goudier Islet I noticed that it avoided certain fine-grained patches, of acid composition, in the granodiorite. An abnormal habitat was the weathered wooden deck of an old whaling scow which had lain on the beach for many years.

GEOGRAPHICAL DISTRIBUTION. Bipolar. In the northern hemisphere it occurs in eastern arctic Siberia (Pitlekai, Behring Straits), and is apparently altogether absent from the western Arctic; in the southern hemisphere, Kerguelen, South Georgia, Graham Land and adjacent islands, and Fuegia. The following is a list of the antarctic localities from which it has previously been recorded:

SOUTH SHETLANDS. *Nelson Island* (Darbshire, 1912).

WEST GRAHAM LAND. *Trinity Peninsula, north coast*: Astrolabe Island and small islet off the coast (Darbshire, 1912). *Palmer Archipelago*: Port Lockroy, Goudier Islet (Hue, 1915); Bob Islet off Wiencke Island (Vainio, 1903). *Mainland coast between Cape Charles and Cape Renard*: Cape Van Beneden (Vainio, 1903). *Kaiser Wilhelm II Archipelago*: Booth Island (Hue, 1909); Hovgaard Island (Hue, 1915).

EAST GRAHAM LAND. *Erebus and Terror Gulf*: Paulet Island (Darbshire, 1912). *James Ross Island*: west side, about lat. 64° (Darbshire, 1912).

[SOUTH GEORGIA. Royal Bay (Reinsch, 1890); Maiviken (May Harbour) (Darbshire, 1912).]

LIST OF LITERATURE

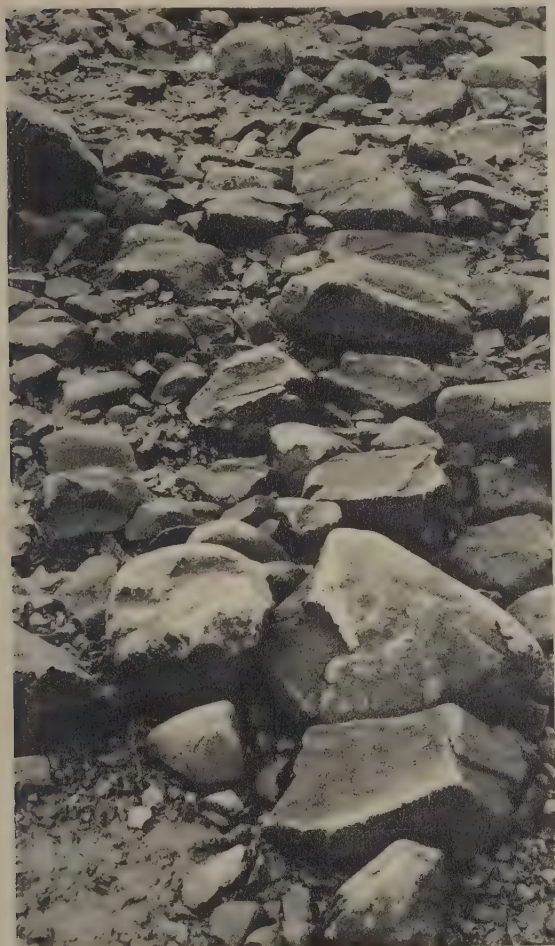
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PLATE I

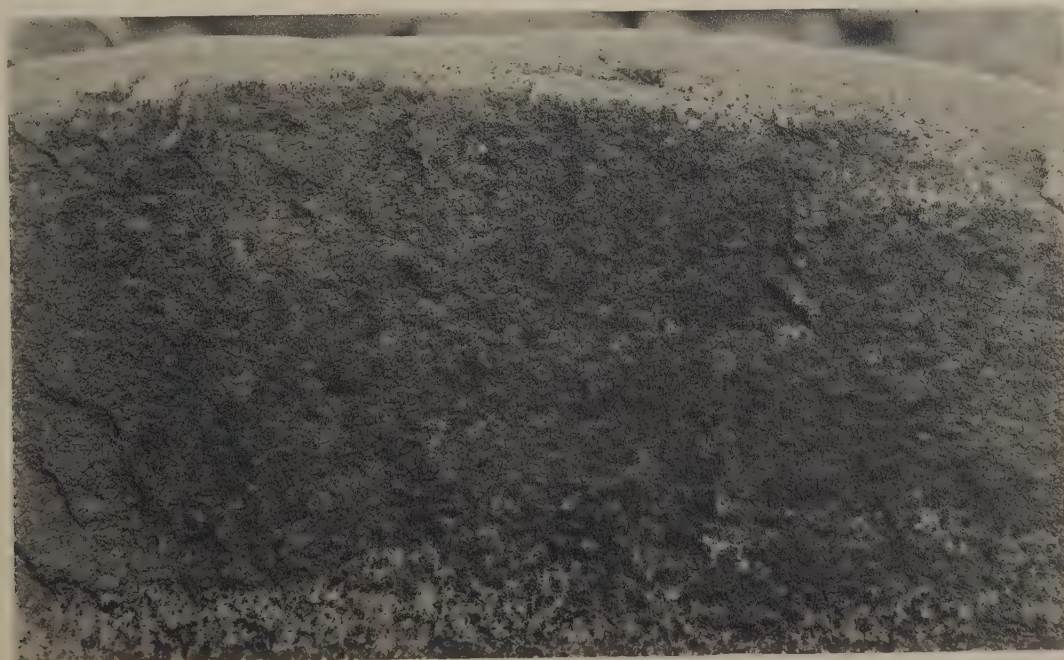
- Fig. 1. Part of the boat harbour, Goudier Islet, Port Lockroy, seen at low tide, showing blackish staining of the rocks caused by *Verrucaria psychrophila* M. Lamb. Phot. I.M.L., 23. iv. 1944.
- Fig. 2. *Verrucaria serpuloides* M. Lamb, forming black patches on submerged granodiorite rocks off the shore of Goudier Islet, Port Lockroy, below the lowest ebb-tide level. (Under-water photograph.) Phot. I.M.L., 19. x. 1944.
- Fig. 3. Close-up view of *Verrucaria psychrophila* M. Lamb, on a boulder in the boat harbour of Goudier Islet, Port Lockroy, at low tide. Phot. I.M.L., 4. xii. 1944.



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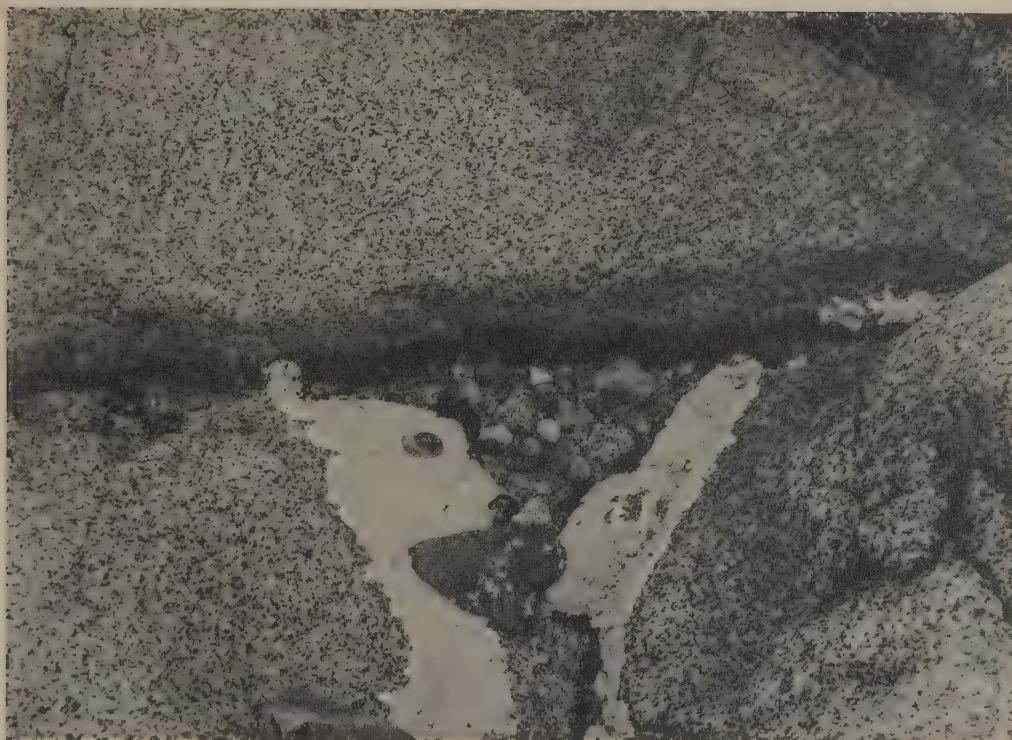


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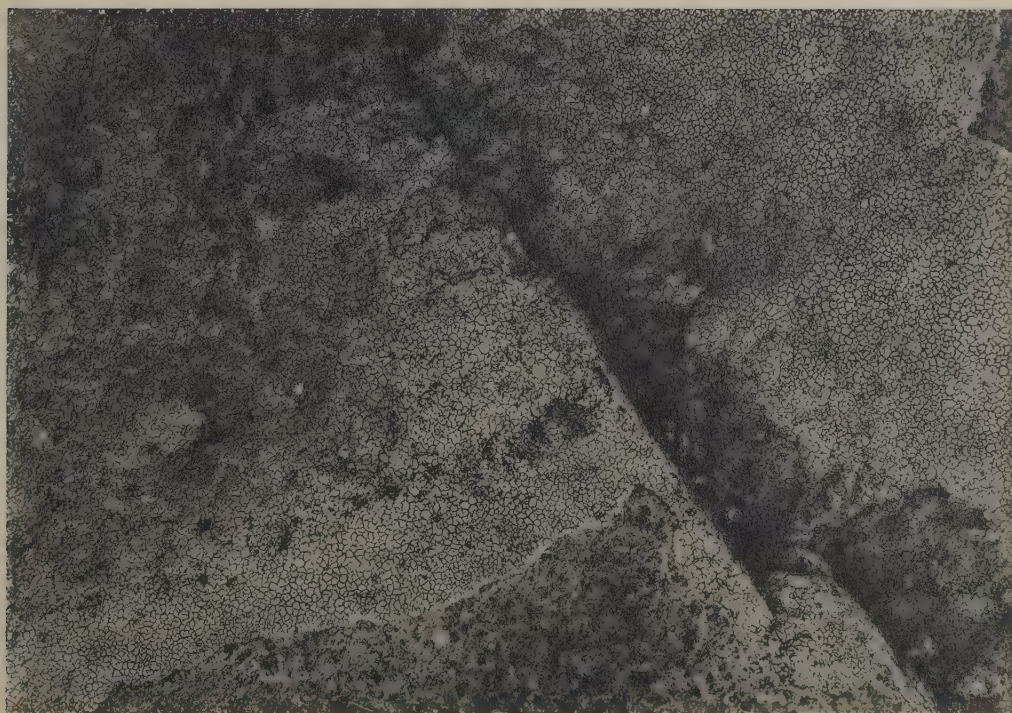
PLATE II

Fig. 1. *Verrucaria serpuloides* M. Lamb, associated with an encrusting calcareous alga (*Lithophyllum* sp.?) in a rock pool, Goudier Islet, Port Lockroy. The *Verrucaria* is seen as a dark band, the upper edge of which marks the level of lowest ebb tide. (Under-water photograph.) Phot. I.M.L., 26. x. 1944.

Fig. 2. Part of an extensive patch of *Verrucaria elaeoplaca* Vain., on a natural gutter in the granodiorite rocks of Goudier Islet, Port Lockroy, periodically moistened by a flow of snowmelt water. $\frac{1}{2}$ nat. size. Phot. I.M.L., 20. xii. 1944.



1



2

PLATE III

Fig. 1. A natural gutter in the granodiorite rocks of Goudier Islet, Port Lockroy, showing growth of *Verrucaria elaeoplaca* Vain. and *Mastodia tessellata* Hook. f. and Harv. Photo. I.M.L., 3. i. 1945.

Fig. 2. A small snowmelt water pool in a hollow of the granodiorite rocks of Goudier Islet, Port Lockroy, with the water level bounded by a zone of *Verrucaria elaeoplaca* Vain. The *Verrucaria* is also seen lining the natural gutter which serves as a run-off from the pool. Phot. I.M.L., 3. i. 1945.



1



2

1900

The first of the series of papers on the life history of the Antarctic seal was published in 1900. It was a preliminary report on the results of the first season's work, and was published in the *Proceedings of the United States National Museum*.

The second paper, published in 1901, was a more detailed report on the life history of the seal, and was published in the *Proceedings of the United States National Museum*.

The third paper, published in 1902, was a report on the life history of the seal, and was published in the *Proceedings of the United States National Museum*.

The fourth paper, published in 1903, was a report on the life history of the seal, and was published in the *Proceedings of the United States National Museum*.

The fifth paper, published in 1904, was a report on the life history of the seal, and was published in the *Proceedings of the United States National Museum*.

The sixth paper, published in 1905, was a report on the life history of the seal, and was published in the *Proceedings of the United States National Museum*.

The seventh paper, published in 1906, was a report on the life history of the seal, and was published in the *Proceedings of the United States National Museum*.

The eighth paper, published in 1907, was a report on the life history of the seal, and was published in the *Proceedings of the United States National Museum*.

The ninth paper, published in 1908, was a report on the life history of the seal, and was published in the *Proceedings of the United States National Museum*.

PLATE IV

Fig. 1. *Mastodia tessellata* Hook. f. and Harv. growing on the $\pm$ vertical north-facing side of a bird-frequented granodiorite rock on Goudier Islet, Port Lockroy. Above are seen stages in the transition into the free-living alga *Prasiola crispa*, which replaces the *Mastodia* on the zenith surface of the rock. Also present: *Caloplaca elegans* Th. Fr. $\frac{1}{4}$ nat. size. Phot. I.M.L., 20. xii. 1944.

Fig. 2. *Verrucaria Racovitzae* Vain.; holotype specimen (above). The lower, coarsely rimose thallus is *Verrucaria elaeoplaca* f. *glaucoplaca* (Vain.) M. Lamb. $\times 4$.

Fig. 3. *Verrucaria famelica* Darbish.; syntype specimen in herb. Kew. $\times 4$.

Fig. 4. *Verrucaria cylindrophora* Vain.; part of the holotype specimen. $\times 4$.

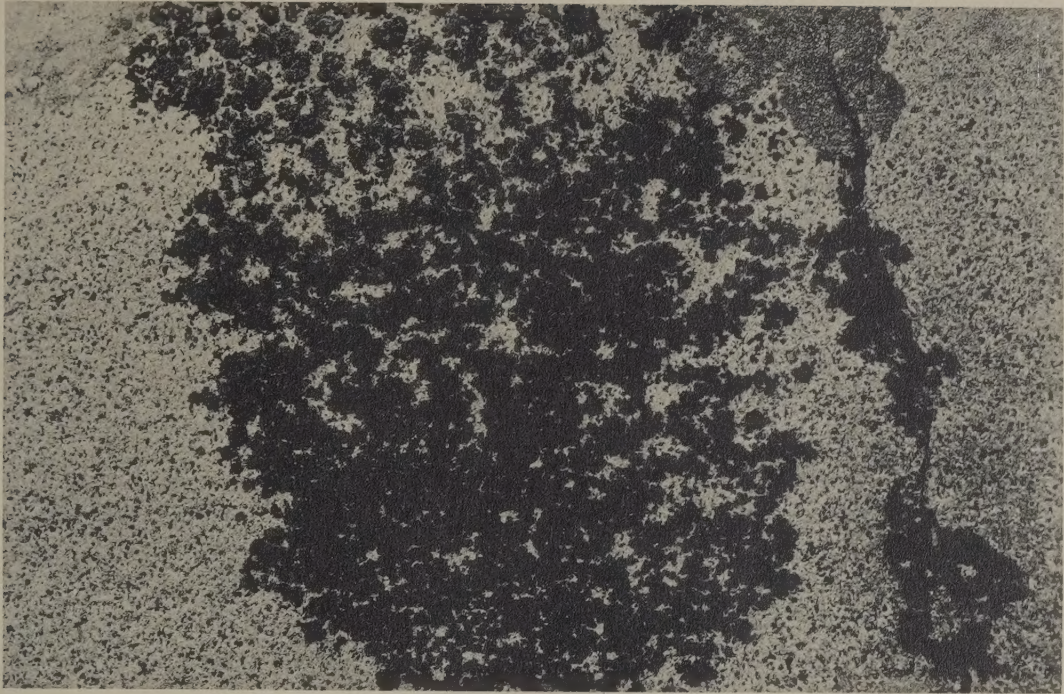
Fig. 5. *Microglæna antarctica* M. Lamb; part of the holotype specimen. $\times 4$.

Fig. 6. *Verrucaria dispartita* Vain.; part of the holotype specimen. $\times 4$.

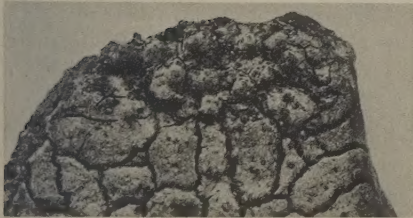
Fig. 7. *Verrucaria psychrophila* M. Lamb; part of the holotype specimen. $\times 4$.

Fig. 8. *Verrucaria serpuloides* M. Lamb; part of the holotype specimen. $\times 4$.

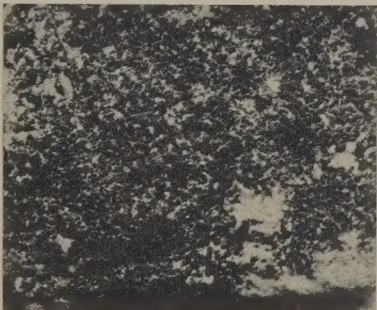
Fig. 9. *Verrucaria tessellatula* f. *dermoplaca* (Nyl.) M. Lamb; part of syntype specimen in herb. Kew. $\times 4$.



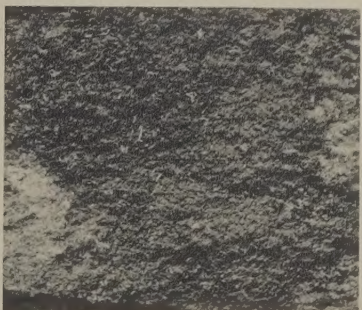
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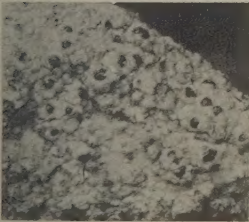
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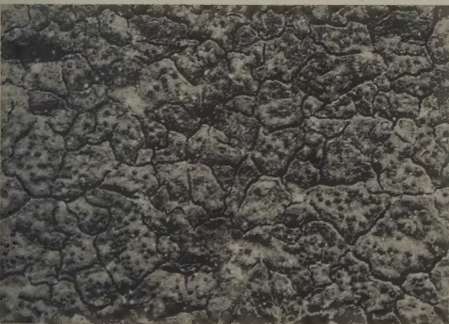
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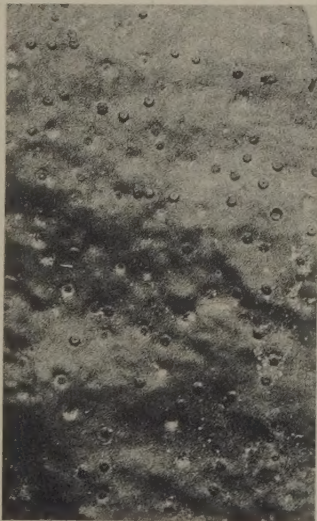
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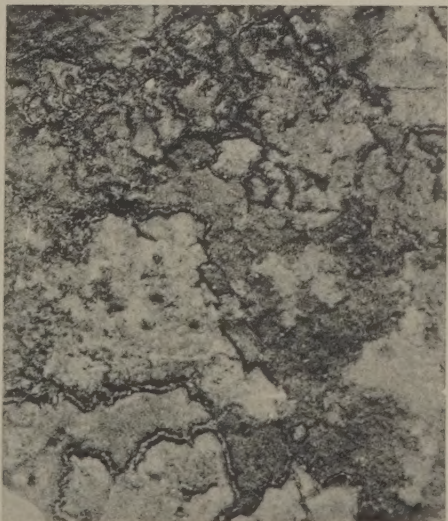
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